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THE BRAINCASE OF THE CARBONIFEROUS CROSSOPTERYGIAN MEGALICHTHYS NITIDUS

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INTRODUCTION

Below is given an account of the braincase and closely associated structures of the Permo-Carboniferous rhipidistian crossopterygian *Megalichthys nitidus* (Cope). At a later time I propose to describe the remainder of the cranial anatomy of this fish.

The rhipidistian crossopterygians are of great phylogenetic importance, since they are unquestionably the closest known relatives of the ancestors of land vertebrates. But despite the great advances made during recent years by Watson, Stensiö and others in our knowledge of the anatomy of paleozoic fossil fishes their braincase is still very inadequately known. A complete summary of the existing literature is given by Holmgren and Stensiö (1936). In 1919 Bryant showed that the *Eusthenopteron* braincase was composed of two major segments, pictured the main outlines of these elements, but found little interpretable detail. Watson and Stensiö have since published revised restorations of the palate in which some features of the braincase are visible and the latter has published a side view of the braincase with a number of foramina identified. Watson has published a lateral view of the braincase of *Osteolepis,* a photograph of a natural cast of the ear cavities and brief description of other salient features of this genus. This comprises our entire knowledge of the rhipidistian braincase; the internal structure is as yet almost unknown, although Stensiö has promised a future study based on sections of *Eusthenopteron* material.

The coelacanths, the only other group of crossopterygians (since *Polypterus* is now generally acknowledged not to belong to this stock) are obviously aberrant and degenerate, but nevertheless of interest. A number of late paleozoic and mesozoic genera have been described by Stensiö, Watson and Aldinger. These show a great reduction in ossification and their interpretation depends upon comparison with more primitive members of the group. For knowledge of such primitive types we are dependent upon two Devonian specimens described by Stensiö. One is a nearly complete braincase of *Diplocercides,* which has been described by Stensiö upon several occasions. He has figured the lateral surface and several cross-sections and promises a fuller

future account of the knowledge derived from the sections. A second specimen is the anterior part of a skull described as *Dictyonosteus arcticus,* which agrees in general with *Diplocercides;* this form is of somewhat uncertain phylogentic position but, as Stensiö has shown, it shows coelacanth affinities.

Megalichthys nitidus was described many years ago by Cope, but until recently material has been exceedingly rare and consequently little morphological information was available. During the past few years however a considerable quantity of material has been collected by field parties under the writer's direction, and the description given is based upon this material. All the specimens are from the various formations of the Wichita group of the Texas "redbeds," a group which lies close to the boundary between the Carboniferous and Permian and which the writer (1936) has recently argued is to be regarded as late Carboniferous, essentially Stephanian, in age. The description is based mainly upon the following specimens, all except one being in the collections of the Museum of Comparative Zoölogy, Harvard University:

No. 6494. A skull nearly complete and little damaged except for weathering in the rostral and nasal capsule region. Belle Plains formation, valley of Little Wichita River, Baylor Co. This has been sectioned vertically at half-millimeter intervals by the "peel" method which, as I have recently noted (1936a), I have used for vertebrate material with success.

No. 6495. A skull, crushed flat and eroded dorsally, sectioned at much closer intervals in a horizontal plain. Moran Formation, head of Cottonwood Creek, Archer Co.

No. 6496. Posterior half of braincase. Admiral Formation, Rattlesnake Canyon, Archer Co.

No. 6497. Anterior half of braincase. Probably Moran Formation. West of Anarene, Archer Co.

No. 6. Walker Museum. Posterior half of braincase. Probably Admiral Formation; 12 miles northeast of Wichita Falls, Wichita Co.

No. 6498. Anterior half of braincase. Probably Moran Formation. West of Anarene, Archer Co.

No. 6499. A number of specimens, mainly somewhat immature, Belle Plains Formation, Tit Mountain, Archer Co.

The figures are a composite, based for internal structures on No. 6494 and for the external surfaces on Nos. 6496 and 6497, except for details in which these specimens were imperfect. The size is that of the sectioned specimen, which appears to be that of the average

adult. Most specimens appear to have been within 10% of the size represented; a few, apparently immature, as much as 20% smaller.

Otico-occipital, dorsal aspect

From above (fig. 1) the posterior moiety of the braincase shows three main areas: (1) a central region lying under the "parietals," covering the braincase and the most medial portion of the ear capsule; (2) a backwardly directed occipital region; (3) on either side an expanded otic region.

In the central region the braincase extends upward to reach the under side of the "parietal" bones, to which it is tightly fused. Because of this fusion, the surface has been seen only in section, and small details cannot be made out. I have found no foramina piercing the dorsal surface. There is a slight hollowing medially somewhat back of the middle of the "parietal" area. Posteriorly small vessels (not indicated in the figure) appear to extend forward beneath the "parietals" to the ossification centers of these elements.

Posteriorly the dorsal surface dips to terminate in a triangular shelf overhung slightly by the posterior ends of the "parietals." The surface here is irregular, the details varying from specimen to specimen; there are indications of the point of entrance of small blood vessels on to the shelf from the postero-lateral borders. On the surface of the shelf rested the anterior margins of the extrascapulars.

It must be emphasized in connection with the often assumed homologization of these bones with the tetrapod tabulars and dermal-supra-occipitals, that the connection is a loose one; they are not in any sense integral parts of the skull proper.

Laterally a thin layer of bone continuous with the perichondral layer of the braincase runs out under the "supratemporal" and is fused to that element. In the figure this has been cut away on the right side to show the extent of the fossa lying beneath it and above the otic capsule. Half way forward, close to the division between "supratemporal" and "intertemporal" a solid ridge extends outward from the braincase proper; this contains the anterior vertical canal of the ear. There is little evidence of any extension from the brain-case roofing the fossa which lies beneath the "intertemporal" element anterior to this ridge. Overlying the foramen for the trigeminus nerve there is a short lateral dorsal projection from the margin of the braincase. Anteriorly the dorsal surface terminates in a thin irregular edge beneath the anterior edge of the "parietals."

Occipital Region

(Figs. 1, 2, 4, 5). This may be defined as the constricted portion of the braincase lying posterior to the foramina for nerve X, containing the posterior portion of the brain cavity and notochordal canal, offering points of articulation with the vertebral column and, laterally, affording areas of attachment for the most anterior myomeres.

Centrally situated on the posterior aspect is the comparatively small foramen magnum. Above, a median ridge, separating right and left portions of the axial musculature, leads upward to the dorsal shelf described earlier. Below is seen the posterior opening of a large canal which runs forward beneath the cranial cavity. This cavity has been generally believed to house an unconstricted anterior portion of the notochord. More recently Stensiö (1932) has suggested that it housed a set of muscles which pulled the anterior segment of the braincase downward on the otico-occipital segment. The present material shows, I think conclusively, that the earlier idea is the correct one. The notochord in the vertebral region of *Megalichthys* was surrounded laterally by bony central elements whose diameter was similar to that of the canal now discussed. Although *in situ* articulation of vertebral column and skull is not seen in my material, it is certain that the most anterior central elements fitted upon the posterior borders of the canal. There is no trace of, or space for a notochordal pit above the canal and below the endocranial cavity and an abrupt anterior terminus for a large notochord is quite unknown in any vertebrate. It seems obvious that the notochord continued forward through this subcranial canal; further evidence for this view will be given later.

A conspicuous feature of the sides of the occipital region is the presence of a series of dorsoventral ridges which divide the surface into three antero-posterior segments. It seems certain that these represent the imprint of three successive myomeres, and suggest the incorporation into the skull of the corresponding skeletal materials. The forward and upward slant of the posterior end of the occiput, however, indicates that there has not been a complete incorporation of the skeletal materials corresponding to the third myomere; presumably some sort of pro-atlantal structure may have been present dorsally. The presence of three occipital myomeres agrees with the condition in *Ceratodus* (Greil, 1913) while the other living lungfish have three somites in the embryo but only two myomeres persist. Two to three myomeres appear in general in the development of amphibians. The presence of three occipital myomeres may well have been a characteris-

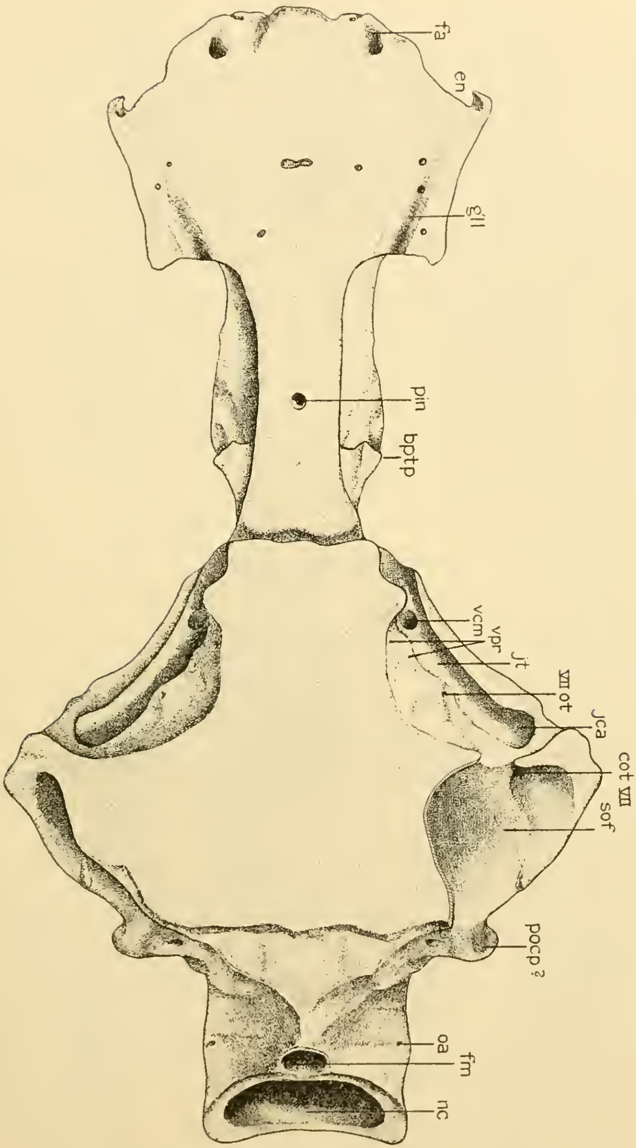

Fig. 1. Dorsal view of the Megalichthys braincase, x 3/2. On the right side a thin sheet of bone overlying the supraotic fossa has been removed.

tic of the common ancestors of lungfish, crossopterygians and tetrapods.

Within the area of attachment of each of the first two myomeres is seen the opening of a small canal. These canals, as noted elsewhere, were for nerves which seem highly comparable to the two hypoglossal roots found in many amniotes, and the term hypoglossals may, I think, be applied to them, rather than the terminology applied to the variable occipital nerve elements of other fish groups.

No such nerve is found associated with the third muscle segment; its nerve presumably emerged posterior to the foramen magnum.

Between the areas of the second and third muscle segments is found the external opening of a canal which passes up within the substance of the bone from the ventral aortic groove. This obviously carried an intersegmental artery. From its upper opening varying radiating grooves indicate its branches. No such canal is found between the first and second segments; presumably this single artery carried the entire blood supply to the occipital area.

The great depth of the brain case in the occipital region is, of course, due to the presence of the huge notochordal canal; this extends forward a distance beneath the otic region; in side view a portion of the lateral wall of its anterior end is visible.

The ventral surface of the occipital region is nearly flat. Just inside the lateral margins is seen a pair of deep grooves, diverging anteriorly and terminating at about the junction of occipital and otic regions. These grooves obviously carried the lateral aortae. The abrupt anterior termination of the canals indicates that at this point the aortae, followed forward, curved sharply downwardly and somewhat laterally.

Otic region, dorsal aspect

Seen dorsally (fig. 1) the otic region extends outward from the main stem of the braincase as a triangular structure, with a median base and the apex at a prominent lateral projection. This has been termed the parotic process, and the name may be retained for descriptive purposes, although it is by no means certain that it is homologous with all of the processes so named in other vertebrate groups.

The otic region is divided above into two areas by a series of structures running inward from the parotic process. The most medial of these structures is the ridge, noted earlier, which surrounds the most antero-lateral portion of the anterior vertical semicircular canal; this ridge is fused to the overlying dermal bones. Halfway out (the canal

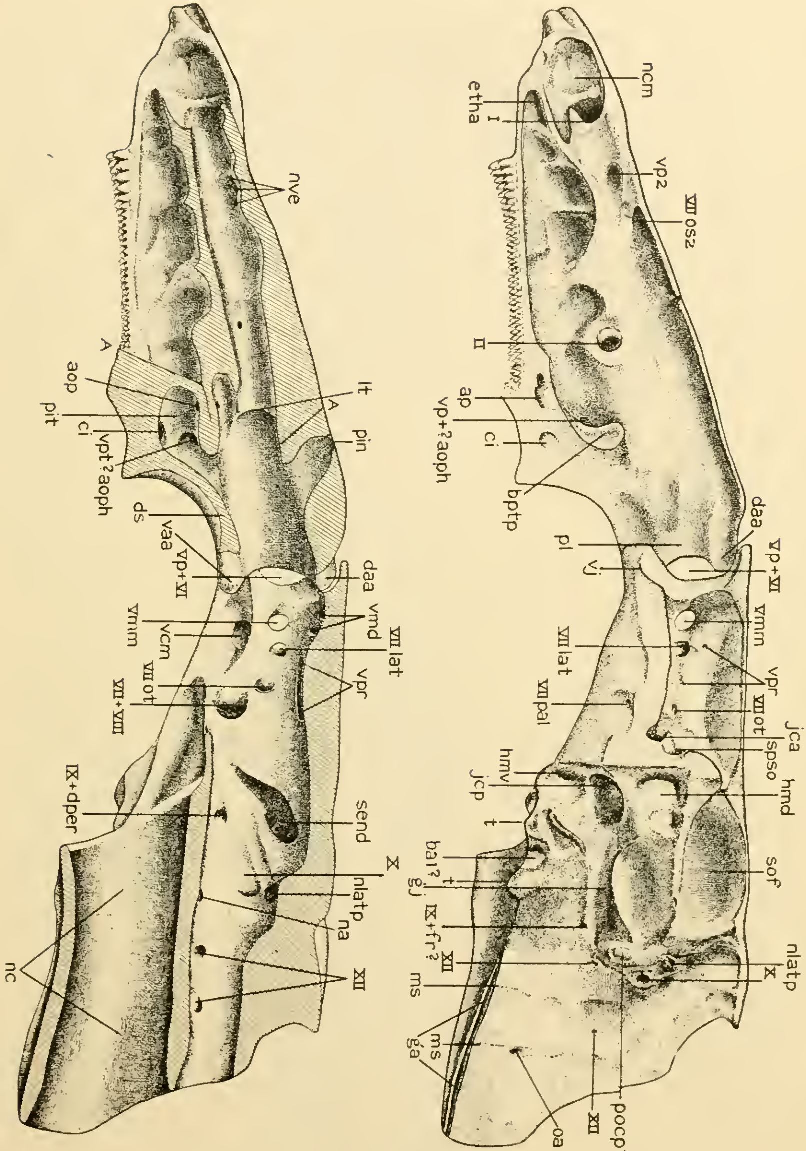

Fig. 2. (right) Lateral view of the braincase. Fig. 3. (left). Longitudinal section. Posteriorly the section is sagittal; anterior to the lines A-A it follows the left olfactory tract to the nasal capsule. Both x 3/2.

here having curved far ventrally) the ridge ceases, and the fossae anterior and posterior to the ridge are in communication through a large fenestra. I know of no important structure which might have passed through this fenestra, although, for example, there may have been some small artery which may have been the predecessor of the important (pseudo) temporal artery of the anurans. The fenestra was bridged above not only by the dermal roof but also, apparently, by a thin film of bone pertaining to the braincase itself.

Distal to the fenestra the braincase again rises to form a dorsal buttress to the parotic process. This buttress is again fused to the dermal roof, in the "supra-temporal" region. Although I have not completed a study of the dermal elements, it would appear that the dermal shoulder girdle attached near this point. If this be true, it may be concluded that the overlying area of the dermal roof corresponds in general to the tabular region of the tetrapod skull and that this region of the crossopterygian braincase is homologous with part, at least, of that portion of the otic region which in primitive amphibians lies beneath the tabular area. This process is pierced by a small foramen, lying beneath the course of the lateral line canal. It was probably traversed by the hypotic ramus of the facial nerve, which supplied this canal.

Posterior to the series of structures just described lies a large fossa, roofed by a thin sheet of bone. Postero-medially it is bounded by a ridge running outward to cover the distal part of the posterior vertical semicircular canal. Since the fossa overlies most of the internal ear it may be termed the supraotic fossa. It opens out postero-laterally, the ventral margin of the opening being formed by a curved ridge which covers the arc of the horizontal semicircular canal and terminates antero-laterally at the dorsal parotic buttress. Half way along the course of this ridge is a small but well marked tubercle which may have served as a point of muscular attachment.

Within the lateral portion of the floor of the fossa at least one specimen shows a faint groove curving backward and inward from the small foramen which presumably carried the hypotic ramus of nerve VII. It presumably follows the course of the ramus communicans VII — X found in many fishes. I know of no important structures which might have occupied this fossa.

Opisthotic region

(Figs. 2, 4) The lateral apex of the parotic process is formed by a dorso-ventral ridge which separates the lateral aspect of the otic

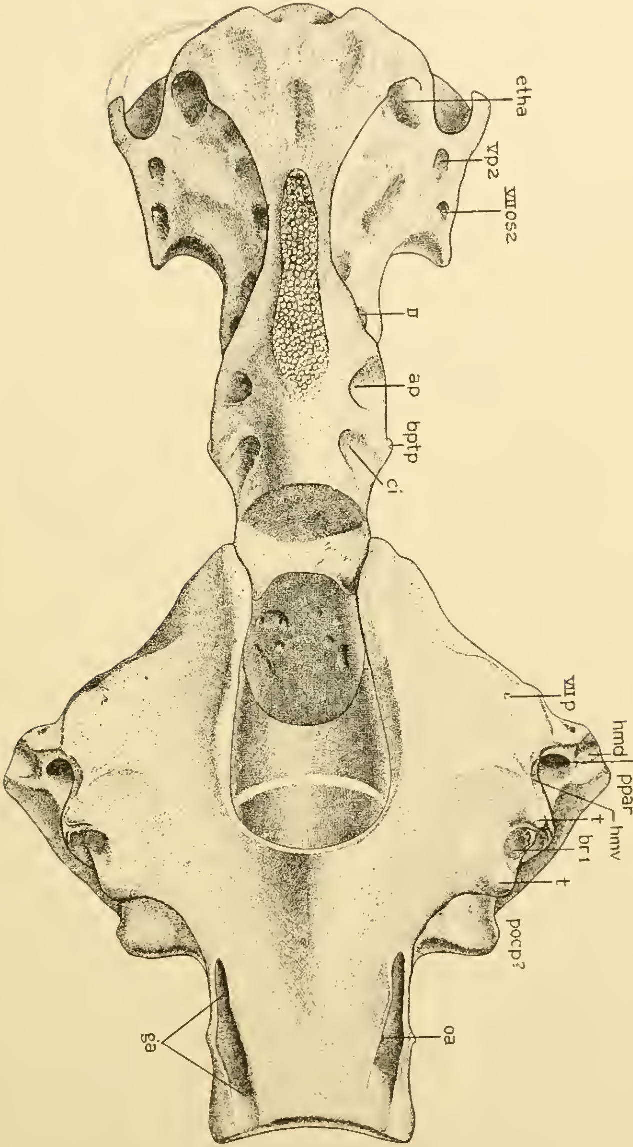

Fig. 4. Ventral view of the braincase. x 3/2.

region into an anterior temporal or prootic region facing rather anteriorly, and a posterior region, facing as much posteriorly as laterally. This latter area, here described, corresponds roughly to the opisthotic region of tetrapods. It is bounded anteriorly by the ridge just mentioned, dorsally by the sharp ridge below the supraotic fossa, ventrally by a sharp line of demarcation setting off the under surface of the braincase, and posteriorly by a vertical line beyond which the braincase turns abruptly back into the occipital region. Part way down the posterior side of the vertical ridge of the parotic process is the posterior opening of a large canal, obviously the jugular canal. In addition to carrying the vena capitis lateralis, the sections show that the canal carrying the hyomandibular trunk of nerve VII opens into the bottom of the jugular canal and that this nerve also must have emerged to the surface here. While there is no positive proof, comparisons make it certain that the orbital or "external carotoid" artery, homologous with the temporal or stapedial of higher forms, passed forward through the same opening.

Dorsal to this opening is a depressed area, lacking a perichondral bony surface, and obviously articular in nature. Ventral to the canal is another large area of like nature. As noted below, these are the points of attachment of the hyomandibular. Farther back along the ventral margin is a third articular area, probably for the first branchial arch.

Posterior to the jugular canal the course of the vena capitis lateralis is well defined by a depression bounded dorsally and ventrally by ridges. This groove terminates well back along the opisthotic surface; here the contours indicate that the vein turned somewhat laterally and ventrally on its way to the ductus cuvierii.

Overhanging the posterior end of the venous groove is a massive process, the tip of which was frequently unossified. It was obviously an important point of attachment. The sectioned specimen indicates an articulation with a posterior member of the branchial arch series. Although I do not feel competent at the present time to discuss this matter, this process suggests analogy to and possibly homology with the "paroccipital process" of primitive reptiles, and this term may be provisionally used for the process under discussion.

The ridge bordering the dorsal margin of the channel for the vena capitis lateralis commences posteriorly at the "paroccipital process" and runs somewhat ventrally as well as anteriorly. Possibly it may have formed a point of attachment for the opercular muscles (cf. Griel 1913). Above it a rounded groove runs backward and upward between the "paroccipital process" and the posterior rim of the supra-

otic fossa. This groove may have carried a blood supply to the muscles of the area lateral to the occiput. The corresponding ventral ridge, on the other hand, fades out posteriorly; anteriorly it curves downward sharply behind the ventral hyomandibular articulation. Anterior to the ridge there is a small area between it and the ventral hyomandibular articular area through which the orbital artery may have emerged from the ventral surface of the braincase. This is an appropriate place for the passage of this artery. The ventral ridge posterior to this position prevents the consideration of a more posterior

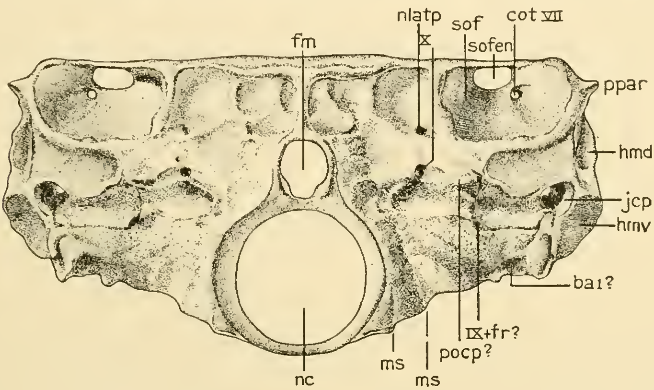

Fig. 5. Posterior view of the otico-occipital portion of the braincase. x 3/2.

course. It is highly reasonable to expect this artery to originate in the region of the hyoid arch; in some fishes, for example, it actually arises from the upper end of the second arch rather than from the dorsal aorta. Between the ridge and the posterior ventral articular area there is a deep but smoothly rounded groove, the function of which I do not know. Possibly it marks the course of a hyoid vein. At the ventral margin of the posterior end of the venous groove is found a foramen which is seen in the sectioned specimen to lead out of the cavity of the internal ear, well posteriorly and at about the point of junction of saccular and utricular regions. As noted later, I believe this to be the external opening of nerve IX, with which may have been associated an incipient fenestra rotunda.

Along the ventral margin of the lateral opishtotic surface are two small tubers; comparison with *Ceratodus* suggests that they afforded origin for branchial arch levator muscles.

At the posterior margin of the opisthotic region are found two foramina which mark the external openings of canals leading from the endocranial cavity. One is situated behind the base of the ridge enclosing the posterior vertical canal. The second is situated more ventrally and posteriorly behind the paroccipital process; it is the larger of the two. It appears certain that they represent the points of exit of the nerves of the vagus group. I think it probable, as noted in the discussion of the brain, that the upper carried the posterior lateralis nerve, the lower the remaining components of the vagus. The lower in addition may have included a vena cerebralis posterior, although the latter cannot have been of any great size. Both foramina may vary in showing a small accessory opening, somewhat dorsal to the main one or an intermediate condition in which this is represented by a notch in the margin of the main opening. These smaller openings presumably were for dorsal rami.

The anterior opening of the notochordal canal is found centrally beneath the opisthotic region. Laterally there is a broad expanse of bone underlying the saccular region; sections show part of this bony layer to be quite thin. About opposite the parotic process there is a low transverse ridge facing rather anteriorly and probably forming a base for ligaments which would have attached anteriorly to the notochordal sheath or posterior margins of the parasphenoid, thus strengthening the union of the two halves of the braincase. Presumably these ligaments were derived from the same superficial membranous sheet in which, in other fishes and in tetrapods, the posterior portion of the parasphenoid ossifies.

Structural features of the hyomandibular region

Although I have not completed my study of the visceral skeleton, the tentative restoration of the hyomandibular is of interest. This large element was found close beside the parotic region in the sectioned specimen, and actually articulated on one side. The head of the bone is divided into two subcircular articular areas which fitted the two corresponding depressions on the parotic crest. The two are connected anteriorly by a thin crest of bone which was in line with the ridge terminating the parotic process; the anterior surface of the hyomandibular appears to have continued the plane of the anterior surface of the process, running parallel to the adjacent palatoquadrate.

Between the two heads is the proximal end of a canal which ran outward along the shaft and emerged distally on the dorso-external

surface of the bone. One is tempted to suggest that this is the opening for a "stapedial" (here orbital) artery, as in the tetrapod stapes. But the external opening of the canal is placed too far distally for this to have been the case. Obviously it was a canal for the hyomandibular nerve, as in actinopterygians.

The relations of the hyomandibular to the otic region and the jugular canal tend to shed light on several interesting morphological problems.

The contrasting attachment of the hyomandibular in existing fish groups—ventral to the vena capitis lateralis in elasmobranchs, dorsal to the vein and commonly to the nerve in actinopterygians—has been a source of puzzlement to many morphologists; compare, for example, the discussion in Goodrich (1930 p. 416 ff.). Of the various suggestions made in this regard we may note three of interest. (1) Stensiö has pointed out that a change in position of a single insertion might take place by the head travelling along the outside of the jugular canal. (2) De Beer has suggested on theoretical ground that both dorsal and ventral attachments were primitively present. (3) Goodrich suggests that the presence of a canal in the hyomandibular of holosteans and at least some palaeoniscids may aid in accounting for the varied position of the nerve in forms which lack this opening.

The situation seen in *Megalichthys* indicates that all three of these suggestions may be essentially correct, if we may (not unreasonably, I think) assume that the conditions seen here are really primitive. The hyomandibular attachment is along the edge of the jugular canal and migration of the attachment would be readily possible. In the attachments of the *Megalichthys* element we have a concrete example of DeBeer's theoretical double dorsal and ventral attachment. Loss of the dorsal head could give the elasmobranch relation to the vein, loss of the ventral head the actinopterygian condition. The presence here, as in primitive actinopterygians, of a perforation of the bone for the nerve suggests that this canal may have been general in early fishes. The canal enters the bone proximally between the two heads; loss of either head would make the disappearance of the canal a relatively simple matter.

Of interest is the light shed by the *Megalichthys* hyomandibular on the development of the stapes (or columnella, *s.l.*) of tetrapods. The morphology of the tetrapod middle ear has been thoroughly and clearly summarized by Goodrich (1930, Ch. VIII).

The most important features are: (1) the course of the hyomandibular nerve or its equivalent backward over and down behind the

stapes; (2) a dorsal process abutting against the otic region and above the nerve and lateral head vein (the process well developed in reptiles, degenerate in mammals); (3) the stapedial or temporal (=orbital) artery running upward through an opening in the stapes (in mammals; in most reptiles the columnella is single headed, and the artery loops up and over it from below and behind).

In the stapes of the early reptile *Captorhinus* recently described by Price (1935) these features are clearly seen. The basal portion is perforated for the stapedial artery, and there is a well developed dorsal process. In contrast with *Megalichthys* there is no nerve foramen. This substitution of openings is readily correlated with the development of the foot plate. The primitive orbital artery curved up close beside the ventral hyomandibular articulation. With the expansion of the foot plate, the ventral head of the bone would tend to become stouter and include the artery within its substance. Wider separation of the two heads, for functional "reasons," would tend to eliminate the bony tissue between them and release the nerve from its canal.

Temporal Region

(Figs. 2, 4). The lateral portion of the braincase anterior to the "parotic process" corresponds closely to the area of the proötic ossification of primitive tetrapods. The lateral surface of this "temporal" region faces nearly as much anteriorly as laterally. The median boundary is formed by the wall of the braincase proper, the posterior boundary by a line running outward to the parotic process. The surface is essentially concave both in dorso-ventral view and in vertical section.

The anterior opening of the jugular canal lies at the ventro-posterior corner of the temporal area. Its opening is in great measure concealed from view by the presence of a high thin shelf which runs from this point forward almost to the anterior end of the bone. This is essentially the posterior part of the subocular shelf of De Beer (1926), although the term is not appropriate here. Within this shelf is a long, well-marked trough which obviously was occupied by the vena capitis lateralis running backward from the orbital region to the jugular canal. Beneath the trigeminal region a large canal opens into this trough from behind. This issues from a space, noted later, beneath the brain cavity and indicates the point of emergence of the middle cerebral vein, here following the original course of the vena capitis medialis, although with an opposite direction of flow. The size of its opening

suggests that this vein drained the major part of the endocranial cavity. Above the anterior opening of the jugular canal there is a concave area on the anterior face of the parotic process which is partially roofed by the expanded dorsal end of this process and in some cases partially separated ventrally from the jugular vein by a thin bridge of bone extending in from the lateral shelf of the jugular trough (this process is absent in the sectioned specimen). The spiracular opening appears to have been situated just lateral and anterior to the summit of the parotic process and it is reasonable to assume that the pocket formed here was occupied by a spiracular sense organ after the fashion of living dipnoans.

About a third of the way forward along the course of the jugular trough a small tubercle projects outward over the medial side. From this point a ridge leads up and back to a second tubercle a short distance in front of the fenestra leading to the supraotic fossa. I do not know with what attachments these structures were concerned. Behind the ridge there opens postero-laterally the small canal which obviously carried the hypotic ramus of the facialis. From its opening a smooth triangular area indicates the course of branches of this nerve outward to the spiracular organ and backward and upward to the small foramen in the parotic crest leading back beneath the lateral line to the supraotic fossa.

Two small openings, one a short distance anterior to the hypotic VII foramen, a second farther forward and higher, are the entrances for small canals which, as discussed below, appear to have carried veins which drained inward from the temporal fossa to the cerebellar region.

Well anteriorly two larger foramina are found opening out above the jugular trough. The posterior one is the smaller, and is directed rather anteriorly and slightly dorsally from beneath an overhanging ridge. This may be interpreted as an opening for the lateralis elements of the facial nerve. The more anterior opening is larger and faces more laterally. This presumably carried V_2 and V_3. Anterior to this foramen a ridge descends from a lateral projection of the dorsal surface which has been seen in the dorsal view. A thinner bony area in front of this ridge terminates the lateral surface of the otico-occipital. In front is a gap between the two halves of the braincase. This afforded a point of exit for the profundus and very likely nerve VI as well.

A series of ridges along the outer face of the lateral boundary of the jugular trough may have given attachment to fascia or musculature. They mark the lateral boundary of the somewhat concave ventral

surface of the proötic region. On this surface well laterally is found the forwardly directed opening for the palatine branch of the facial.

In the temporal region are found the elements which in actinopterygians make up the typical trigemino-facialis chamber of Allis' descriptions (1919 etc.). They are, however, here widely dispersed, and cannot be said to form a chamber in any sense. The lateral wall of the actinopterygian chamber is confined here to the outer margin of the jugular trough and the far-laterally placed outer wall of the jugular canal. The pars ganglionaris (recess) is well separated from the diffuse area representing the pars jugularis.

As noted earlier the notochordal canal opens out ventrally far back in the otic region, and continues forward as an open channel; there is no ventral connection between the two proötic regions, although the median walls swing down ventrally so as to cover a part of the sides of the canal. These walls are somewhat imperfect, even in the sectioned specimen, and I cannot be sure that the outline as figured is correct.

As Stensiö has noted, this ventral opening in itself is not a true (posterior) basicranial fenestra; it is merely an opening into the notochordal canal. Between the canal and brain cavity a partition persists forward to a point somewhat anterior to the level of the parotic processes. In front of this is a large true basicranial fenestra closed in front only by the posterior margin of the anterior segment of the braincase.

Ethmo-sphenoid, dorsal aspect

(Fig. 1) The anterior moiety of the braincase is narrow behind, where it lies beneath the median portion of the "frontals": anteriorly it expands rapidly, underlies the elements of the rostral shield, sends out marked antorbital processes, and terminates anteriorly in widely separated nasal capsules and a slightly projecting rostral region. It is solidly fused to the overlying elements (it is, however, only loosely attached to the premaxillae). In consequence this dorsal surface is drawn from reconstructions of the sectioned specimen and the finer details are uncertain.

In general the dorsal surface exhibits a gentle slope downward and forward, with a slight lateral downward curvature in the antorbital and nasal region and a slight concavity in the middle of the ethmoid region. The pineal, although not penetrating the dermal roof, reaches the roof of the braincase beneath the "frontals." Grooves underlying the

thickened area of the elements bearing the supraorbital lateral line canals run forward and laterally over the antorbital region, gradually fading out distally. Several openings lead upward into this groove from the underlying lateralis nerve, and there are a number of openings presumably for vessels leading to the centers of ossification of the overlying dermal elements; as noted below, their restoration is none too certain and I have probably missed several of these small canals.

Parasphenoid, basilar articulation and related structures

(Figs. 2, 4) Although a dermal bone, the parasphenoid is, as usual so integral an element of the braincase complex and so difficult to separate from it, even arbitrarily, that it must be considered here.

Along much of the ventral mid line of the ethmosphenoid the parasphenoid bears an elongate oval plate thickly studded with small but sharp conical teeth. The anterior termination of this tooth-bearing plate projects well below the level of the braincase, with which it is connected by a longitudinal ridge composed of dermal bone. Anteriorly the parasphenoid is superficially in contact with the "vomers"; but a thin radiating sheet of bone which appears to be continuous with the parasphenoid spreads far forward over the lower surface of the inter-nasal area of the braincase.

Posteriorly a flange develops along the sides of the parasphenoidal rostrum, formed ventrally of dermal bone and dorsally of cartilage replacement bone. The median edge of the palatoquadrate complex fits onto the upper surface of this flange so that (as in primitive amphibians and even *Seymouria*) there is practically no interpterygoid vacuity. Posteriorly the flanges flare out widely, and the postero-ventral termination of this half of the braincase has the section of a hemi-cylinder, the core composed of endochondral bone, the surface of parasphenoidal tissue which gradually fades out far dorsally along the posterior end of the sphenoid region.

On either side two slit-like openings penetrate the parasphenoid, curving down and in toward the midline. Here within the substance of the parasphenoid the two channels communicate with each other and with the floor of the pituitary fossa through a network of sinuses difficult to interpret in section. It seems certain that the posterior opening is that of the internal carotid. The anterior one obviously is the homologue of the tetrapod palatine artery. It cannot be considered as the ophthalmic (in the sense of Goodrich and De Beer) since it is ventral to the trabecular region. Radiating lines indicate the branch-

ing of the palatine external to its opening. Surface markings running down to the carotid opening from far up around the sides of the posterior end of the sphenoid region indicate that more posteriorly the carotid was situated at a comparatively high level and lateral to the expanded anterior end of the notochord.

The broad posterior portion of the lateral flanges of the parasphenoid curve widely upward and outward to encircle on either side a stout process formed of endochondral bone; the circular outer faces of these processes are turned somewhat anteriorly as well as laterally. These articulated movably with the palatoquadrate complex and are highly comparable with the basipterygoid processes of primitive reptiles and amphibians.

It is frequently assumed that the basilar connection between braincase and primary upper jaw was primitively a connection between the cartilages or replacing bony elements of these structures, and that the presence of dermal bones in this articulation represents a secondary condition. But it will be noted that the present process contains not only an endochondral core, but a dermal outer layer. The connection is already a compound one, and this double participation in the basal articulation is obviously an ancient character.

Interorbital Region

The ethmo-sphenoid terminates posteriorly in a series of structures discussed in a later section: ventrally the concavity for the anterior end of the notochord; half way up a pair of posteriorly directed articular processes; dorsally a similar pair. Between these two sets of articulations the lateral margin is formed by a rounded pillar of bone. This has been termed the "alisphenoid wulst" by Stensiö in comparison with a seemingly similar region of the actinopterygian skull. The term, however, is misleading, since in neither case are we dealing with a homologue of the true alisphenoid region of mammals. The term laterosphenoid pillar seems more appropriate.

There is little lateral development of this region and no apparent evidence dorsally of the palato-quadrate articulation found here in coelacanths. In relation to this fact, the pillar is not traversed by a canal for the superficial ophthalmic, nor is there any opening for the profundus, which surely emerged behind the pillar and passed forward lateral to it.

Anterior to the laterosphenoid pillar, the dorsal half of the lateral wall of the braincase is a fairly smooth sheet of bone, somewhat con-

cave above, somewhat expanded below over the side of the mid- and forebrain regions. A foramen for nerve IV should be present here, but I am unable to find it. A tiny foramen of this sort is easy to miss in section, and my material does not show the surface at all perfectly in this region.

A shallow groove extends backward along the lateral margin of the sphenoid region from the top of the basipterygoid process. This obviously marks the position of the anterior end of the vena capitis lateralis on its way to enter the trough in the temporal region. This groove descends anteriorly into a deep pocket partially concealed by the basipterygoid process. This presumably was occupied, in part at least, by the posterior end of an infra-orbital sinus. A large foramen leads from this pocket into the pituitary fossa and was obviously traversed by the pituitary vein. I can find no opening for the ophthalmic vein which in most fishes passes outward dorsal to the trabeculae and well posterior to the orbit. It it existed it must have used this same opening.

The large optic foramen emerges on the anterior side of a prominence which may have served as the point of origin for the rectus muscles. To my embarrassment I have been unable to discover, either in sections or whole specimens, an oculomotor foramen.

It is obvious that there is not the slightest development of the myodome characteristic of the actinopterygians. The muscles concerned are well forward of their assumed point of entrance into the skull via the pituitary vein channel.

Ethmoid Region

The more anterior regions of the braincase are best seen in ventral view (fig. 4). In the mid-ventral area the lateral margins of the flanges of the parasphenoid region curve out anteriorly, leaving a broad and rather flat subrostral area between them: as noted previously much of this area appears to have a film of parasphenoidal bone on its surface. In the midline is a groove which may have received processes from the dorsal surface of the medial edges of the "vomers." At the ventral anterior margin is a depression which lodged the palatal processes of the premaxillae with their large teeth. Laterally are a pair of pockets which appear to have been open to the roof of the mouth between premaxillae and "vomers" and received the tips of a large pair of lower jaw teeth.

On the dorsal surface of the braincase a pair of canals emerge

medial to the nasal capsules; they presumably carried bloodvessels and nerves to the rostral region; the details of their distribution are variable and none too clear.

The ventral part of the lateral ethmoidal surface, below the expansion caused by the underlying olfactory tract, is occupied by a series of pockets, variable in their arrangement. Possibly they were for the most part occupied by glandular structures. Anteriorly, beneath the median side of the nasal capsule, the series terminates in a deeper cavity which, unlike the others, lacks an ossified surface layer. In the sectioned specimen this pocket is occupied by the anterior end of the palato-quadrate; this is obviously the ethmoidal articulation. It will be noted that from here back to the basal articulation the palato-quadrate complex is in practically continuous contact with the base of the braincase. If this condition is at all primitive, it is easy to see how intermediate types of articulation may have evolved.

Dorsally the braincase sends out a thin antorbital process; the lateral ethmoidal region gradually thickens anteriorly to the nasal capsule. On the under side two canals enter this process. The more posterior and dorsal one surely carried the lateralis nerve; the more anterior one, entering at a lower level, presumably carried the profundus and accompanying blood vessels forward to the nasal and snout region.

The nasal capsules are widely separated, with a thick mass of bone between them. The olfactory canal enters the posterior portion of the median wall of the capsule by a large circular opening, not well seen in the figures. Anterior to it, and quite distinct from its opening, is an equally large circular pocket in the median wall, subdivided by irregular ridges. This presumably lodged a median diverticulum of the nasal cavity, possibly homologous with the tetrapod Jacobson's organ.

In none of my specimens are the thin dorsal and lateral walls of the nasal capsule completely preserved, and the outlines of the opening of the capsule given in the figures are a composite of which I am none too confident. It is certain, however, that the capsule opened widely antero-laterally toward the external nostril, and ventrally to the choana; there was no bony solum nasi, although, of course, such a structure might have been developed in cartilage.

Notochord; intra-cranial kinetics

Some evidence has been previously cited to show that the great ventral canal beneath otico-occipital was occupied by the undiminished

anterior end of the notochord. In median section (fig. 3) this canal and related structures may be clearly seen. The canal continues forward with perfectly smooth walls beneath the posterior portion of the otic region. Farther forward the ventral wall disappears; still farther forward the dorsal wall. But an open cavity of equal diameter continues forward beneath the anterior end of the otico-occipital. Anteriorly this cavity terminates in a hemispherical pocket in the posterior end of the ethmo-sphenoid; the diameter of this pocket is almost exactly that of the canal, with which it is almost exactly in line. It is difficult to believe that these areas were occupied by any structure other than an undiminished anterior continuation of the notochord. Still further proof is afforded by the fact that (as seen in section) the anterior termination of the notochordal space is, in the fashion of primitive vertebrates, just posterior to the pituitary.

A final proof is offered by the nature of the bony materials surrounding the notochordal space. The bone of the braincase consists in general of a lightly ossified endochondral reticulum covered in almost every case by a thin perichondral layer. In the lining of the notochordal canal, however, we find a third type of tissue, a dense bone of heavily fibrous nature. This layer terminates abruptly at the anterior end of the notochordal canal, dorsally as well as ventrally. This tissue reappears in the cavity which obviously received the anterior end of the notochord. It is found nowhere else in the skull. But it is found, again, as would be expected, in one other locality—the internal surface of the vertebral centra. In this tissue we are definitely dealing with an ossification in a fibrous sheath surrounding the notochord.

We may then confidently restore the notochord in Megalichthys. In the posterior part of the otico-occipital it was tightly attached to the braincase, and it was again tightly bound anteriorly to the ethmo-sphenoid. Between, in the "proötic" region, it was unattached; its flexibility would tend to allow a certain degree of motion between the two portions of the braincase. Presumably this movement was restricted by a dorsal ligamentous union of "parietals" and "frontals" as well as more indirect lateral dermal connections. Further restrictions were placed in this movement by two sets of articulations between otico-occipital and ethmo-sphenoid moieties, best seen in the section, but also visible in part in other figures.

One pair of connections lies lateral to the floor of the endocranial cavity. On the "proötic" the medial wall of the jugular trough is continued forward beneath the lateral gap between the two halves of the braincase, so as to overlap the adjacent area of the "sphenoid;"

this projection is concave internally. Into the concavity fits a rounded, horizontal ridge on the "sphenoid," which projects back somewhat

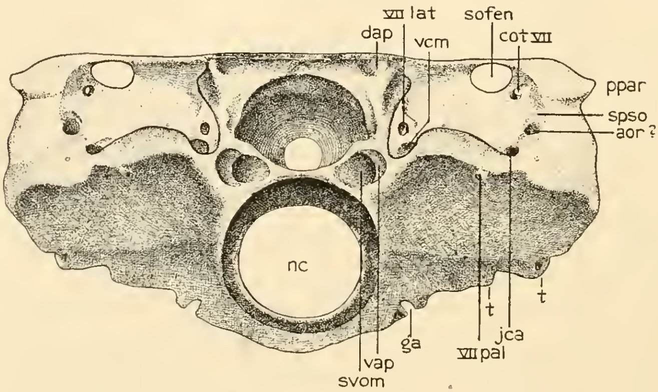

Fig. 6. Anterior view of the otico-occipital portion of the braincase. x 3/2.

from the general posterior margin of the bone at the level of the floor of the braincase. The two opposed surfaces lack perichondral bony coverings; presumably they formed a closely knit joint.

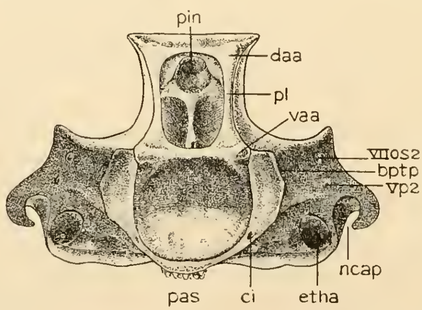

Fig. 7. Posterior view of the ethmo-sphenoid portion of the braincase. x 3/2.

At the dorsal end of the pillar terminating the "proötic" anteriorly there is developed on either side a rounded depression which faces downward and outward. The upper end of each laterosphenoidal

pillar is expended into a rounded knob which faces upward and backward, fitting into the sockets on the posterior bone. The opposed surfaces are smoothly finished by perichondral bone; there is little suggestion of any close connection, and conditions suggest that a bursa intervened.

This whole set of characters, large notochord and two sets of articular surfaces, suggests, as other writers have noted, a kinetic mechanism adapted to lessening the jars which would otherwise be transmitted to the posterior half of the braincase in the seizing and biting of food by these highly predaceous fishes. Presumably the "normal" situation was one in which the anterior segment of the braincase was depressed and a gap present between the upper pair of articular surfaces. When the jaws were snapped on to the prey, the anterior end of the braincase, (as well as the primary and secondary jaws) would "give" upward in the flexure of the notochord beneath the "proötic" region. The ethmo-sphenoid would swing upward with the lower pair of articulations as the pivot; the upper surfaces would swing together, but the shock would be buffered by interposed bursae. With release of pressure, the ventral ligaments would presumably pull the snout downward again without need of any strong musculature for the purpose.

Endocranial Cavity

The brain cavity is displayed in the longitudinal section and reconstructed "moulds" of the internal cavities are shown in figs. 8–10.

The portion of the brain cavity enclosed in the otico-occipital appears essentially to be that of the medulla and cerebellum. Posteriorly, in the region of the spinal medulla, it is a small tubular structure, which gradually expands in breadth and increases in height toward the anterior end of the otico-occipital.

The broad medullary floor is widely open below through the large basicranial fenestra. In the central part of this opening the brain was presumably separated from the underlying notochord only by its meninges. Laterally in this area, however, appear to have been the principal points of exit of venous blood from the brain. Beaneth the lateral walls of the fenestra there is found on either side a large pocket which presumably contained a venous sinus. Outward from this pocket runs a large canal which turns forward and then upward, carrying the middle cerebral vein into the vena capitis lateralis.

From the lateral margin of the floor beneath the vagus region a

canal descends into the substance of the bone lateral to the notochordal canal. Here it branches and ends blindly. It is surely a nutrient vessel. Presumably other such vessels are present, but they are not well enough seen in section to be restored with confidence.

The dorsal surface of the posterior portion of the cavity appears to show a step-wise anterior increase in the height of the brain. A first upward step in the region of nerve X presumably gave the medullary walls their full height; a second step presumably allowed the development of a posterior chorioid plexus, giving way anteriorly to the cerebellum.

Farther forward on the dorsal surface is found a complex system of grooves and small canals. On both sides, above the roots of the facial nerve, is a curved longitudinal groove, from either end of which a small canal leads outward to the temporal region, where the external foramina have been noted. These are too far dorsal to have carried nervous structures. I interpret them as carrying veins inward from the surface to the intra-cranial system. O'Donaghue (1920) has noted the presence of similar vessels in *Sphenodon* and as he notes, Watson finds comparable openings in a number of fossil tetrapod types. Possibly similar structures would be found rather generally if search were made for them.

Still farther forward, behind a transverse ridge in the roof which may mark the anterior end of the cerebellum, small canals are seen to enter the roof, running dorsally in an anterior or antero-lateral direction. I have found them difficult to trace. It is probable that they reach the region of the dorsal articulation between the two halves of the braincase and supply this area with blood vessels.

Lateral openings from the walls of the medullary cavity are numerous. Posteriorly two small canals run out laterally from the lower margin of the medulla. These appear be "occipital" nerves. Their ventral orgin indicates that they are surely somatic motor in nature, and despite their distinct external openings I feel no hesitation in terming them hypoglossals.

More anterior and more dorsal in position, are a pair of large canals which constitute the X-XI complex; their external openings have been noted earlier. The more dorsal (and externally more anterior) of the two arises from a groove high up on the lateral face of the braincase; the more ventral from a larger pocket beneath this. While I feel none too sure, its position suggests that the more dorsal one was occupied by the posterior lateralis nerve, the groove leading to it indicating its roots from the lateralis tract of the medulla. Presumably

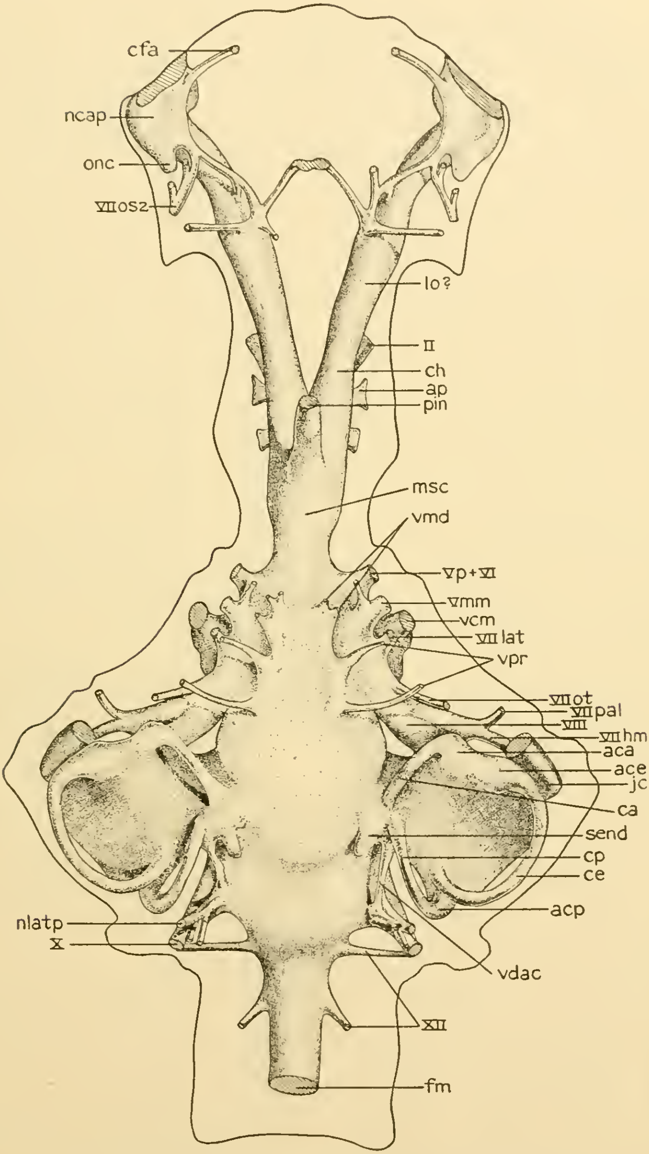

Fig. 8. Endocranial cavities in dorsal view. x 3/2.

the ventral opening carried the other vagal elements, and in all probability a small posterior cerebral vein.

Leaving aside for the time openings into the otic capsule (including nerve IX) there remain for consideration a series of openings pertaining to nerves V-VII-VIII, lying along the inner face of the proötic wall and constituting essentially the acustico-trigemino-facialis recess of Allis (1919).

The most posterior of these is a large canal which runs out laterally into the bone of the proötic region. It soon divides. The larger posterior branch, evidently carrying the entire acoustic nerve, enters the otic capsule. The smaller division, obviously for the main stem of the facialis, runs on laterally just anterior to the auditory capsule, from which it is not completely separated. The main, hyomandibular, ramus runs outward to emerge in the floor of the jugular canal which it undoubtedly traversed to its posterior opening. Proximal to this point a small canal, for the palatine ramus, turns sharply forward to open on the ventral surface beneath the jugular trough.

Next anterior, much smaller and more dorsally situated is a canal for the hypotic ramus of the facial. This runs outward just beneath the surface of the temporal fossa to open above the jugular trough half way to the parotic process. Its probable further course has been noted previously.

Third in the series, also rather dorsally situated, is a fairly large opening which pierces the lateral wall, here thin, in an anterior as well as lateral direction. From its position and direction it presumably carried the anterior lateralis elements (ophthalmicus superficialis and buccalis VII).

Next anterior, somewhat more ventral, and larger is an outwardly directed opening in the wall which I interpret as carrying the trigemis proper (maxillary and mandibular). Within the foramen is a small branch which runs up dorso-anteriorly in the lateral wall of the vertical pillar found here. This may have transmitted a small sensory branch to the joint region of the braincase.

There is a well-marked oval lateral gap between the two halves of the braincase. Since there is no opening anterior to this for the profundus, it must have left the endocranial cavity at this appropriate point; possibly nerve VI as well.

In contrast with the breadth of the medullary region, the more anterior portions of the brain cavity are elongate but narrow. The midbrain region is but little expanded. The diencephalic region is indicated by the large pineal diverticulum.

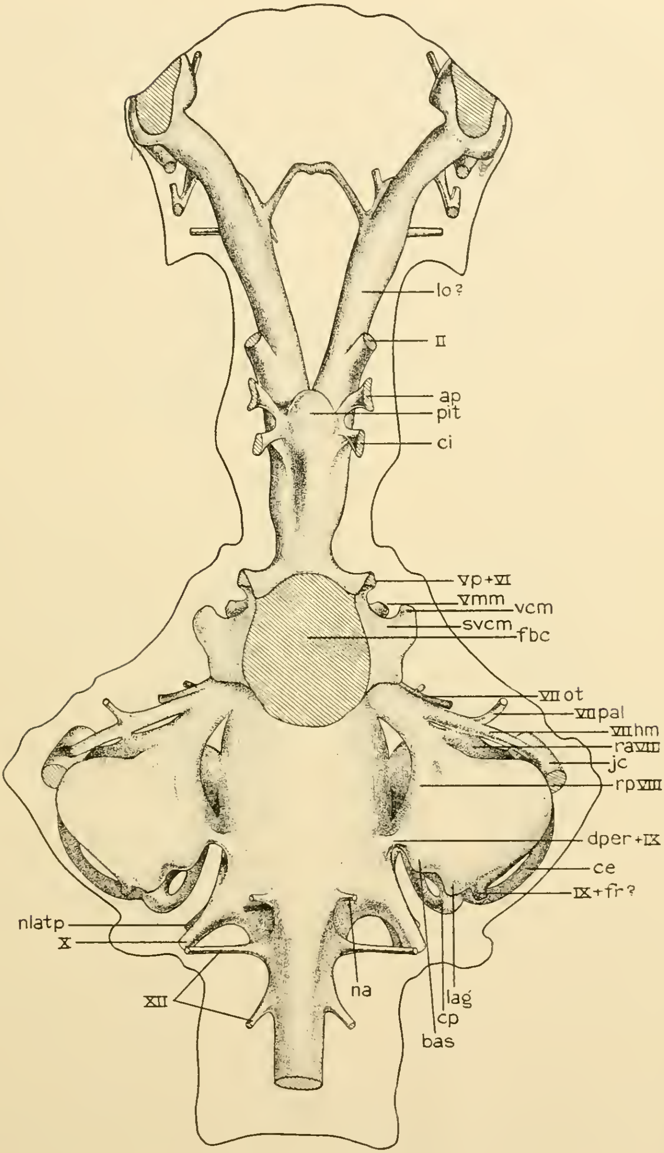

Fig. 9. Endocranial cavities in ventral view. x. 3/2.

The position of the pituitary is of interest. The "dorsum sellae" is not at all dorsal; in contrast to the orthodox vertebrate situation, the floor of the braincase slopes down and forward rather gently into the infundibular region; on the other hand, there is a marked "dorsum" over the anterior part of the fossa. These conditions may be interpreted in the light of the peculiarly large size of the anterior end of the notochord; the pituitary has been pushed forward into an unusual position. The ventral arterial openings and the lateral opening for the pituitary vein and possibly the ophthalmic artery have been noted earlier. On one side of the sectioned specimen a small channel runs upward from the front of the pituitary sac into the base of the brain cavity below the assumed position of the optic nerve. Presumably this carried the optic artery, the independent channel developing because of the unusual position of the pituitary. However I could not trace this channel through on the other side of the same specimen and it appears to be absent in a second.

The optic foramina are far forward, terminating channels which gradually separate from the under side of the cavity of the forebrain.

At a point above the middle of the pituitary fossa and just back of the tip of the pineal diverticulum the brain cavity divides into two, indicating the position of the lamina terminalis. Obviously there can have been but little development of an unpaired telencephalon. Forward there extend from this point two markedly divergent tubes leading to the nasal capsules. The tubes are of nearly uniform size throughout and there are few definite indications of subdivision into regions containing hemispheres, olfactory lobes and more distal olfactory "nerves," although I infer that a marked constriction about two-thirds of the way along each tube marks the end of the olfactory lobe.

There are marked differences in the details of the walls of these tubes from specimen to specimen and even between the two sides of the same specimen. In one case, at least, there is a groove running along the median wall for a considerable distance beyond the point of bifurcation; presumably this was for a blood vessel.

There is a number of small canals in the ethmoidal region, some of which are shown in the figures. I have found them hard to interpret because it is difficult in section to trace these tiny structures through the spongy bone, and a further difficulty lies in the fact that the sectioned specimen is somewhat imperfect on the left side; in the figures I have restored the missing areas on the basis of the right side. In consequence there are probably errors both of omission and commission.

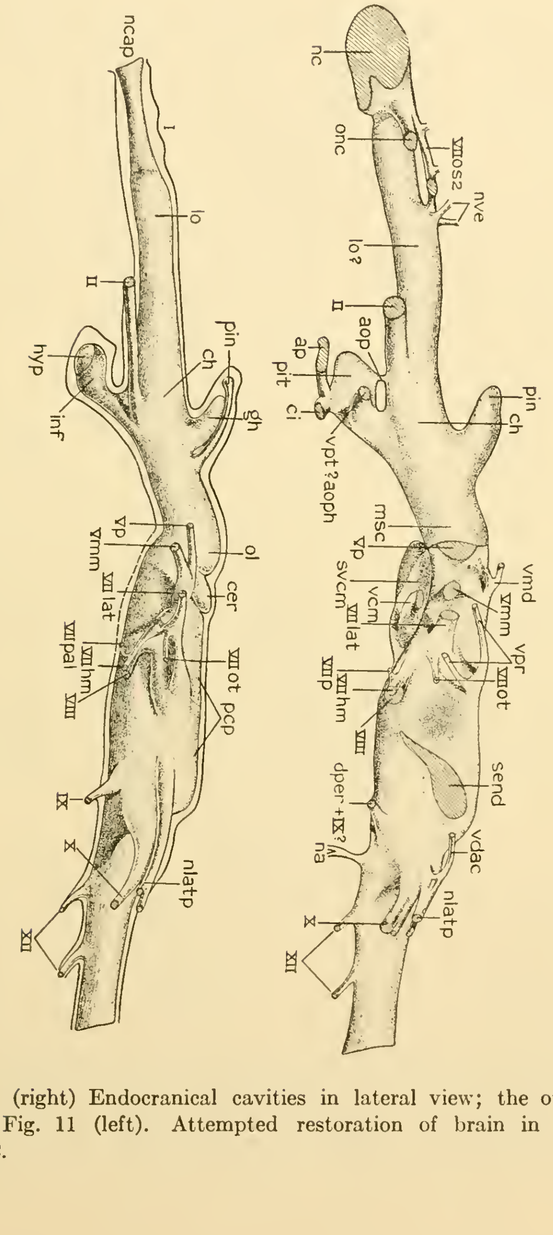

Fig. 10. (right) Endocranical cavities in lateral view; the otic capsule removed. Fig. 11 (left). Attempted restoration of brain in side view. Both x 3/2.

From the "olfactory tubes" a number of small canals branch out to emerge on the surface of the braincase beneath the centers of overlying dermal elements on the ethmoidal shield; presumably they carried nutrient vessels. Several diverge from a common pocket in the region which I assume to have contained the olfactory lobe. The large median "postrostral" is supplied from both sides.

On the right side of the sectioned specimen a small canal splits off from the "olfactory tube" dorsally and runs forward to emerge into the capsule at its dorsal margin over the olfactory nerve. Presumably this carried blood vessels. The left side is imperfect and in the figures I have restored this region as a mirror image of the right side. However in another specimen this separate canal was absent and conditions here appear to have been variable.

In the lateral ethmoidal region a canal which runs forward and inward beneath the position of the lateral line obviously carried ophthalmicus superficialis VII. There are several branches upward from this canal to the cranial roof. It appears to anastomose with the vascular canal mentioned in the last paragraph. Probably it continued antero-medially from this point, but I have been unable to trace it satisfactorily.

A second canal, farther forward on the lateral ethmoid region opens almost immediately into the dorso-posterior part of the nasal capsule. Presumably this carried the profundus nerve and associated blood vessels.

A groove leading anteriorly and medially over the medial wall of the nasal capsule appears to mark the course of the median branch of the profundus to a canal which goes to a "foramen apicale" on the snout.

Nervous system

In figs. 11 and 12 I have attempted to restore the brain and portions of the cranial nerves. The data upon which the restoration is based have been given above, and I need not comment upon it in detail. Such features as, for example, the grooving of the inner surface of the braincase by the vessels above the medulla, indicate that the brain rather fully filled the endocranial cavity. But the comparative thickness of my sections, together with minor imperfections in the endocranial walls, have rendered it difficult to find many details in contours which might have been significant in setting off the regions of the brain. The division between mid- and hind brain areas seems clearly marked, and the position of the various nerves and of epiphysis and

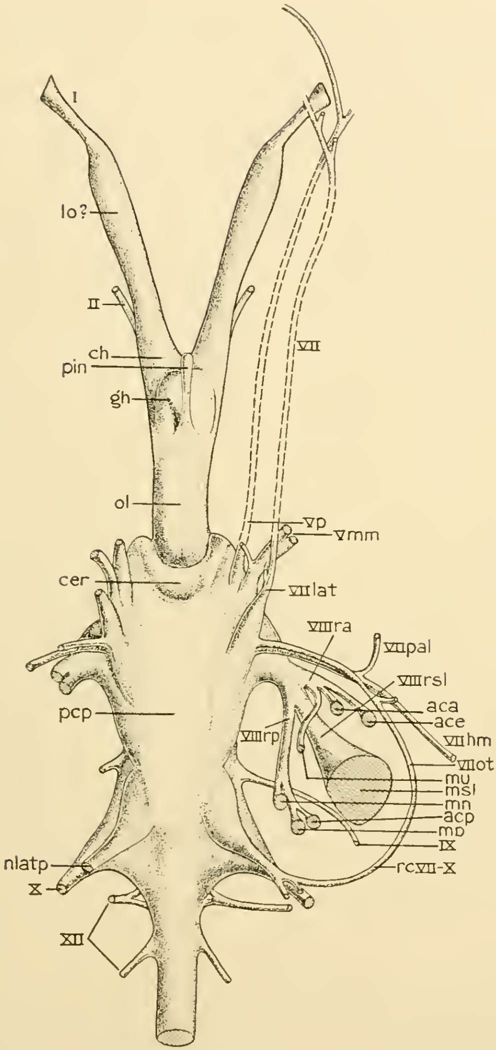

Fig. 12. Attempted restoration of the brain and proximal portions of the nerves in dorsal view. On the right side the ramus communicans VII-X is indicated, the obvious general external course of the ophthalmic nerves is shown in dotted line, and the deduced paths of the rami of nerve VIII are figured. x 3/2.

pituitary renders it certain that in most respects the divisions indicated cannot be far from correct. As noted above, the forebrain region presents the greatest difficulties.

In general I have restricted the restoration of nerves to those portions found enclosed in bone; however, I have indicated the obvious general external course of the ophthalmics and hypotic ramus of VII. On the right side I have indicated, from data given below, the probable course of the subdivisions of the auditory nerve. Because of lack of satisfactory evidence I have omitted the eye muscle nerves.

It is obvious that the brain as restored is essentially similar to that seen in dipnoans on the one hand and amphibians on the other; thus the neurological evidence, as far as it goes, agrees with all other lines of work tending to indicate the close relationship of crossopterygians with these two groups. Of particular interest is the fact that the forebrain here is highly evaginated as in amphibians and lungfish, not merely *Protopterus* and *Lepidosuren* but *Ceratodus* as well (Holmgren and van der Horst 1925) and in contrast to the other fish groups (cf. Herrick 1921). The two hemispheres diverge markedly, instead of lying close beside each other as in both amphibians and lungfish. This may reasonably be considered a primitive condition on the assumption that the developing hemispheres invaded the canals diverging immediately from the old forebrain termination toward the olfactory capsules. The hemispheres lack the peculiar ventral expansions of the living dipnoans; the large lingula of the *Ceratodus* paraphysis cannot have been developed. The large diameter of the pineal diverticulum suggests that "bolsters" containing the habenular ganglia may have been present as in *Ceratodus.* The comparatively small optic lobe region is in correlation with the small eyes of Megalichthys. Some of the details of the nerve openings, as the apparently distinct development of anterior and posterior lateralis nerves, suggests a rather primitive condition.

Circulatory System

In the description of the braincase a number of facts have been noted which shed light upon part of the cranial circulation. These may be summarized here.

We have noted a groove on the under side of the occipital region which was undoubtedly occupied by the lateral aorta, and an occipital artery which passed up from this point to supply the area lateral to the posterior part of the skull. The aorta obviously was curving upward

and backward to enter the groove, suggesting that the arches at least as far back as the tetrapod systemic were placed anterior to the groove.

The orbital artery has left no definite imprint, but its probable course up beside the ventral attachment of the hyomandibular and thence forward through the jugular canal is readily inferred.

The forward course of the internal carotid must have been along the under side of the proötic wall, median to the palatine foramen, rising up alongside the lateral border of the anterior end of the notochord and then curving downward on the parasphenoid to enter its foramen through that bone to the floor of the pituitary fossa. We have noted the re-emergence from the parasphenoid of a palatine artery branching from the carotid within that bone. It has been suggested that small foramina leading upward from the front end of the pituitary fossa indicate an occasional independent course for the intra-cranial part of the optic arteries. There is no positive evidence of the presence of an ophthalmic artery or the related pseudobranchial.

In most respects the arterial circulation thus inferred agrees well with that of other fishes. In many cases the ventral vessels are more deeply embedded in the base of the braincase. The orbital artery here seems to be identical in its relations with that of most actinopterygians. In many selachians and Polypterus it is, however, entirely lateral to the less completely developed "temporal" region and, further, rises up antero-medial to the palatine nerve. In some relachians it is embedded in the braincase, but the relations to the palatine are the same; the foramen is a ventral one.

On the other hand, there is nothing known which would prevent the development of the arterial system into that seen in the tetrapods. The development of the palatine artery, not normally present in fishes, is a distinct indication of dipnoan and tetrapod affinities. As I have noted earlier the course of the orbital is just that to be expected in a morphological predecessor of the temporal of lower tetrapods and the mammalian stapedial.

As has been seen, the course of the vena capitis lateralis is clearly marked; from the pocket in the orbital region containing the pituitary vein backward over the basipterygoid process, along the trough in the lateral margin of the temporal region, through the jugular canal, and back along the outer side of the otic capsule to the level of the vagus. The vein is as usual ventral to the trigeminal, but dorsal to the palatine and hyomandibular divisions of the facial. I have found no anterior cerebral vein, and the posterior cannot have been large. The main drainage from the skull was surely through the middle cerebral,

as described; its course lies beneath the facial, in proper position for the embryonic vena capitis medialis.

The conditions are in harmony with those found in fishes in general. The prominence of the middle cerebral agrees with conditions in amphibians.

In addition to major vessels we have noted various small vascular canals presumably of nutrient nature and small veins draining the temporal and internal ear regions.

Internal Ear

The otic capsule is well ossified internally, and the outlines of the main structures are clearly indicated (Figs. 8, 9, 13). The otic region lies beneath the supraotic fossa and the areas immediately adjacent to it; as has been noted, portions of the canals are enclosed in ridges bounding this fossa. The ventral surface of the ear cavity is separated from the under surface of the otic region by a thin sheet of bone. The ear region is remarkably large by comparison with most other vertebrate types. It is able to gain in depth without projecting ventrally owing to the development of the large notochordal canal; the saccular area is lateral to the canal and extends far below the level of the brain cavity. The main sacculo-utricular cavity may be described as having the shape of a half-filled sack, with a broad base resting on the floor of the otic region, the upper part constricting as it rises inwardly and posteriorly to an apex in the region of the crus commune. Part way up the sack there is a constriction on the outer wall which appears to mark the division between saccular and utricular areas.

The saccular area has a large subcircular and nearly flat floor, which tilts downward toward the outer and anterior margins. Postero-externally there is a depression in the floor which indicates the position of the lagena. In both sides of the sectioned specimen there is preserved a large otolith which covers much of the floor of the saccular cavity. Over much of the surface it is a lens-shaped structure. In the lagenar region it sends down a ventral process which follows the contours of this depression. Along the back wall of the saccular cavity there is a slight out-pocketing suggesting the presence of a papilla basilaris.

There is no positive evidence of a papilla neglecta or amphibiorum, although presumably some structure of this sort must have been present. There is no evidence from the external contours concerning

an utricular recess; it certainly could not have attained the large size of the recess of dipnoans. A small utricular otolith was found on the left side of the sectioned specimen in the region of the crus commune. Presumably this is a post-mortem displacement from an originally more anterior position.

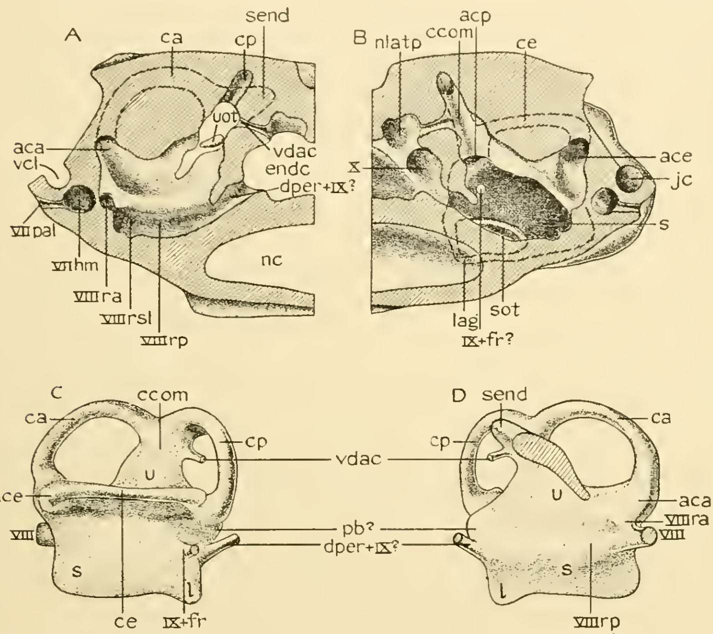

Fig. 13. The ear region of Megalichthys. A, B. sections through the left otic capsule, the cut being a vertical one made diagonally from a point just in front of the jugular canal postero-medially into the braincase in the vagus region. In A the view is in an antero-medial direction; in B, the reverse. C, D, reconstructions of the cavities of the left otic capsule as positive casts. C, lateral view; D, medial view. All x 3/2.

Three semicircular canals are clearly outlined, occupying their normal positions and without obvious peculiarities. Conjoined areas for the ampullae of the anterior and horizontal canals are seen anteriorly. The horizontal and posterior vertical canals have a common area of postero-lateral origin from the end of a ridge which bounds the back border of the utricular area, the end of the horizontal canal lying over the assumed area of the ampulla of the posterior vertical.

For the most part the inner ear is separated from the brain cavity by stout bony walls. There is, however, a remnant of the embryonic connection here in the shape of a long slit which starts rather low anteriorly behind the foramen for nerves VII-VIII and slants backward and upward, widening above, to terminate high up medial to the area of the crus commune. The lower part of this opening appears to have been closed in life by a thin film of bone, remains of which are seen in the sections. By comparison with the usual amphibian condition, it would be assumed that the posterior ramus of nerve VIII entered the capsule through this slit. But the course of the nerve can be better accounted for on the assumption given below.

The upper part of the opening from the internal ear lacks any trace of a wall. This region extends somewhat over the roof of the brain cavity. Here there is developed a pocket which extends a short distance back into the substance of the cranial roof, which is as much a part of the endocranial as of the otic cavity. It may reasonably be assumed that this pocket represents the position of an endolymphatic sac or at least the posterior part of one. There is no evidence of any canal upward to the surface for an external endolymphatic opening.

From this general dorsal terminal area of the otic region a small canal runs back into the base of the canal for the posterior lateralis nerve. It is very clearly seen on the right side; on the left the region is imperfect. I know of no comparable structure. Presumably it carried a small vessel, vein or lymphatic, out from the otic region. I cannot account for it under any theory of origin of perilymphatic structures.

The acoustic nerve enters the otic capsule at its anterior median corner, shortly after it separates from the trunk of the facial. It appears to have divided into two portions almost immediately. One slants steeply upward along the anterior wall to presumably reach the ampullae of the horizontal and anterior vertical canals and the utricular macula.

The larger subdivision appears to have remained at a low level and enters the floor of the saccular area. In the sections there are low ridges which appear to radiate over the saccular floor and indicate the distribution of the nerves to the saccular and lagenar maculae; the possession of a common otolith suggests that these two sensory areas were more or less fused. A groove along the median wall of the saccular floor suggests the position of a posterior ramus which rose posteriorly to the posterior canal and the assumed maculae neglecta and basilaris.

A foramen, noted previously, pierces the outer wall of the capsule at about the junction of saccular and utricular areas close to the postero-

lateral corner of the otic cavity. At the ventral postero-internal corner of the cavity a canal passes into the floor of the braincase anterior to the opening which I assume to have carried the non-lateralis elements of the vagus.

The internal opening seems rather certainly to mark the position of the tetrapod perilymphatic connection with the endocranial cavity.

The external opening appears to be the same as that in the coelacanth *Diplocercides* which Stensiö suggested might be a rudimentary fenestra ovalis. This can hardly be the case; it is far removed from the future stapes and far posterior in position. Its external opening is close beneath the course of the vena capitis lateralis. This suggests that it might have carried a vessel outward from the ear region, a condition unusual but not exceptional, since an analogous opening is found in the venous hypotic duct of some chelonians (Nick 1912).

A possibility involving both these openings which I adopt, although with some hesitation, is that they transmitted the glossopharyngeal nerve (less its usual lateralis component), its course lying along the hind wall of the otic capsule between inner and outer openings. The nerve traverses the capsule in many vertebrates and the external opening is in an appropriate position. The low position of the internal opening into the brain cavity causes some difficulty.

Current theories regarding the development of the tetrapod perilymphatic openings imply that the perilymphatic system first penetrated internally into the base of a jugular foramen of amphibian type (containing IX and X as well as the posterior cerebral vein) and then spread outward along this canal to the surface of the braincase. The fenestra rotunda is assumed to have originated by splitting off from the jugular foramen and rotating forward. If the conditions in *Megalichthys* are representative of those of the tetrapod ancestor, it may well be that this is nearly the reverse of the truth. The external opening of the glossopharyngeal may have been a primitive fenestra rotunda in essentially its definitive position, the internal opening of the glossopharyngeal the primitive perilymphatic foramen. The varied amphibian conditions may be ascribed to a secondary withdrawal of nerve IX from the otic capsule, with consequent, but varied "attempts" of the perilymphatic system to follow the nerve.

General and embryological considerations

Before attempting to compare the *Megalichthys* braincase with that of other forms it seems advisable to attempt to resolve the adult braincase into its probable embryological antecedents (fig. 14). In

doing so I have in general followed the terminology and schemata of Goodrich (1930) and DeBeer (1926, etc.).

The general position of the trabeculae seems clear. They obviously terminated posteriorly alongside the pituitary region and ran forward below the forebrain region, below the optic foramen. If the parasphenoid were removed, the pituitary fossa would still open ventrally to the roof of the mouth as the remains of the early fenestra hypophyseos. The internal carotids enter this opening in typical fashion, below the trabeculae, the pituitary vein emerges above them. The basilar articulation may, as generally, be assumed to represent the approximate position of the polar cartilage.

The broad anterior end of the adult braincase would at first sight suggest a typically platybasic condition of the embryo. But it will be noted that the sphenoidal region is quite narrow below. The trabeculae must have lain quite close together in early stages. The condition would thus have been an intermediate one, from which either platybasic or tropibasic conditions might easily have been derived.

The transverse bar of bone which posteriorly terminates the ethmospheniod in its ventral half, is interposed between the pituitary and the tip of the notochord. The morphological importance of this area has been recently emphasized by DeBeer (1926). The present bar, the "dorsum sellae," is obviously a development of the acrochordal cartilage. Here, as DeBeer believes to be the case generally, the acrochordal is obviously quite distinct in origin from the parachordals, from which it is separated centrally by the posterior basicranial fenestra and laterally by the lower intra-cranial joint.

I shall attempt no analysis of the more anterior supra-trabecular structures of the nasal and ethmoid regions, which appear to vary greatly from group to group. More posteriorly the upper part of the lateral wall of the braincase is obviously developed from the orbital or sphenolateral plate of the embryo. The taenia marginalis, which generally connects orbital and otic regions along the dorsal edge of the braincase is interrupted by the upper intra-cranial articulation. DeBeer (1926) has pointed out the importance of the pila prootica (or antotica), found generally in vertebrates except most actinopterygians and mammals, as a landmark. It runs down from the posterior end of the orbital cartilage, posterior to nerves II and III and the pituitary vein, anterior to the proötic incisure or foramen and hence anterior to nerves V and VII (except that the profundus may be embedded in the pila). It generally extends upward the line of the dorsum sellae.

This is an exact definition of the region which I have termed the laterosphenoid pillar, bounding the ethmo-sphenoid posteriorly above the notochord.

A pila lateralis of actinopterygian type should be outside this area, lateral to the head vein, profundus and anterior lateral line nerve. Obviously this structure is non-existent in *Megalichthys.*

My uncertainty as to the course of nerve III renders the position of the pila metoptica uncertain.

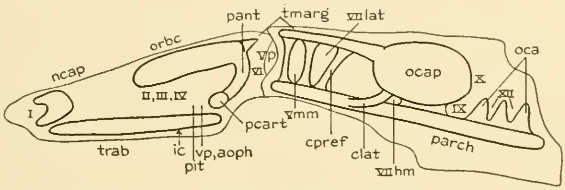

Fig. 14. Attempted analysis of the embryonic components of the Megalichthys braincase.

Just as the trabeculae appear to form the essential structure of the ethmo-sphenoid half of the adult *Megalichthys* skull, so the parachordals are obviously the structural base of the otico-occipital moiety. Posteriorly they have obviously fused both below the notochord and above it to form a basal plate; anteriorly they are widely separated by the persistent basicranial fenestra, through which the middle cerebral vein enters the braincase. Posteriorly the presence of two hypoglossal elements suggests that three arches have fused to form the occipital region. The general region of the embryonic otic capsule is obvious. The metotic fissure has, of course, closed except for the foramina of nerves IX and X. Dorsally otic and occipital structures have fused to form a solid roof to the braincase. As has been seen, the otic capsule still retains part of its original internal opening.

Anterior to the otic capsule proper the "proötic" region has a complicated structure. Much of the upper margin of this region may be assumed to be formed by the posterior part of the taenia marginalis extending forward from the capsule; the lower by the anterior ends of the parachordals. Here lie a large number of openings and canals, the osseous divisions between which may be analyzed in terms of commissures.

The prefacial commissure is by definition that part of the cranial wall lying between the facialis (proper) and the trigeminal (including

profundus) and lateralis VII. In *Megalichthys* the facial (excluding lateralis) extends far out laterally in the temporal region before emerging by various exits. Hence the prefacial commissure in a broad sense includes much of the surface of the "temporal" fossa; its basic portion may be regarded as the area of the side wall of the braincase just back of the opening for the lateralis nerve.

With the development of the prefacial commissure we have the embryonic proötic foramen divided into two major areas. In *Megalichthys* we find both of these subdivided to an extent not seen, as far as I am aware, in any other type of fish (except the Polypterini). The anterior region is subdivided by two further commissures, one between the lateralis opening and the trigemenus proper, the second, terminating the lateral wall of the temporal region anteriorly, between V2 & V3 and the lateral gap behind the pila antotica through which V1 and VI presumably emerged.

The three posterior components of the facialis (otic, hyomandibular and palatine) are embedded in a solid mass of bone continuous with the anterior wall of the otic capsule. It is difficult to analyse this mass in terms of commissures. The lateral part of the temporal wall may be in part the postpalatine commissure. The area of bone separating the otic ramus from the main trunk of the facial may be considered in theory as till another, unnamed, commissure. The most lateral part of the otic region, the outer face of the parotic process is, by definition, the lateral commissure of DeBeer.

As has been seen above, the two moieties of the adult *Megalichthys* braincase correspond essentially to the two major regions of the embryonic vertebrate chrondrocranium; the trabeculae and polar cartilages and overlying structures anteriorly, and the parachordals and related elements posteriorly. Further, this adult subdivision appears to represent a basic distinction between two modes of origin of skeletal material. For both the observations of Miss Platt and the experimental work of Stone indicate that the trabecular region is derived from the neural crest and thus related in embryonic origin to the visceral arches, while the parachordals and more posterior structures are derived from typical axial mesenchyme. Dr. W. K. Gregory has suggested to the writer that the condition in rhipidistians might be considered a retention of a primitive vertebrate character. This suggestion is a stimulating one and worthy of serious consideration. At present, however, the weight of paleontological evidence is in the other direction. For the time at least we must, I think, adopt the opposite hypothesis, that the intracranial joint and associated structures are a

specialization which has arisen within the group as a retention in the adult of an essentially embryonic condition.

In an analysis of skull structure such as that of the earlier part of this section, the general procedure is to erect a simple framework and then fill out the edifice by the addition of commissures, taeniae, etc. This is essentially a description of actual embryological history. Implicit however in much of this type of discussion is the assumption that these processes are also a recapitulation of phylogeny; that the primitive gnathostome had a rather simple cranial structure which was gradually expanded and complicated in various later forms.

But our increasing knowledge of early vertebrate history shows that in many cases groups have not "advanced" structurally, but have degenerated, as Watson, for example, has repeatedly shown. Further, as especially illustrated by the work of Stensiö, the oldest vertebrates show no tendency to exhibit the theoretically simple structure of an "archetype." Existing evidence points strongly toward the point of view that the primitive gnathostome had a braincase of expanded and complicated structure. I shall return to this point in a concluding section.

Comparison with other crossopterygians

Such knowledge as we possess of the braincase of other crossopterygians may be reviewed in the light of the structure seen fairly completely in *Megalichthys.* A complete summary of our earlier knowledge, with references to all earlier literature is given in a recent work by Holmgren and Stensiö (1936) and detailed references are omitted here.

Watson in 1926 figured a lateral view of the braincase of *Osteolepis macrolepidotus.* The general topography appears to be similar to that in *Megalichthys,* although the specimen is incomplete and many details could not be made out. The openings for nerves I, II and superficial ophthalmic VII are properly identified, as is the jugular canal. The general area of the hyomandibular attachment is indicated, but the details appear not to have been visible and only a single head is indicated. The opening marked "VII" is perhaps that for the otic ramus of that nerve. A foramen for nerve III is shown in a position which suggests the opening for the pituitary vein. The groove bounding the vena capitis lateralis anterior to the jugular canal is shown, but not identified. Stensiö has published an emended copy of this figure. In it the pituitary vein is, I believe, correctly identified and a small foramen unlabelled by Watson is presumably correctly assigned

to the superior ophthalmic. Other changes made in the identifications appear to be less happy. The anterior opening of the jugular canal is suggested as the opening for the otic ramus of VII.

In addition to the figure mentioned, Watson described a number of other features of the brain case of *Osteolepis*. With few exceptions this description could be applied word for word to *Megalichthys*.

Bryant's pioneer work of 1919 on *Eusthenopteron* was of fundamental importance in establishing the double nature of the braincase, but he was unable at that time to interpret its structure in any detail. Subsequently Stensiö has figured the braincase of *Eusthenopteron foordi* in side view and has promised a future description of serial section work in progress on this genus. The side view as figured is comparable in many respects to *Megalichthys*. Openings for the oculomotor nerve and the arteria ophthalmica magna, which I have failed to find, are indicated. All three areas of attachment in the hyomandibular region are figured, but only the dorsal area is labelled.

The antero-lateral region of the otico-occipital above the jugular trough and the area between the two moieties of the braincase are assumed to have been filled with a solid sheet of cartilage. This is improbable; since *Eusthenopteron* appears, as far as our knowledge goes, to resemble *Megalichthys* markedly in other features of the braincase, it is probable that better material would show that the construction here was the same.

Except for a few scattered observations, I have cited all work done on rhipidistian crossopterygian braincase structure. The facts are scanty, but such as they are they suggest that *Megalichthys* may be taken as a typical member of the group.

Of the more aberrant crossopterygians, the coelacanths, many of the forms described are Mesozoic types which are obviously specialized and degenerate and need not be discussed here. Of great interest, however, is the Devonian *Diplocercides*. This has a well ossified braincase which has been described by Stensiö on several occasions; serial sections have been made, but only preliminary notes of the results are as yet published.

The ethmosphenoid of this coelacanth is in many ways comparable to that of *Megalichthys*. In the orbit, in addition to the openings found in the latter form, Stensiö shows foramina for nerve III and the ophthalmica magna. A pronounced point of difference is the development of a large "antotical process" at the upper posterior border for an articulation with the ascending process of the palatoquadrate, an articulation which he considers a secondary one. The presence of this

process results in the backward extension of the furrow lying beneath the supraorbital lateral line canal, and in the enclosure of much of the superficial ophthalmic in a canal through the substance of this process. A seemingly important difference between conditions here and in *Megalichthys* and, it would seem, other rhipidistians, is the perforation of this process by a canal which Stensio interprets as transmitting the profundus nerve. This fact, presumably, has led him to the conclusion (1936 p. 347) that the split in the braincase comes at the back end of the trigeminus opening and hence that in such a form as *Diplocercides* part of the otic region is included in the ethmosphenoid half of the braincase. But presumably the inclusion of the profundus in the "laterosphenoid pillar" or pila antotica is also related to the development of the upper palato-quadrate articulation; as De Beer (1926) notes, the profundus, although emerging from the braincase posterior to the pila antotica (prootica) may become enclosed in that element.

In Stensiö's specimen the occipital region is apparently missing. A single opening is indicated in the vagal region, rather than the two seen in Megalichthys. An external opening from the otic capsule comparable to that seen in *Megalichthys* is interpreted as possibly a fenestra ovalis; nerve IX is stated to emerge close beside but separately from the opening. A typical jugular canal seems to be present. It is assumed that the facial nerve emerged to the surface at about the point where the otic ramus emerges in *Megalichthys* and that the hyomandibular ramus then turns backward into the jugular canal. Possibly, however, the hyomandibular ramus may have followed its internal course as in rhipidistians. There appears to be no outer rim to the jugular furrow. Antero-laterally the otico-occipital is poorly ossified, for the area whence normally issue all branches of the trigeminus, the anterior lateralis and the middle cerebral vein is represented by a single large gap, uncrossed by any osseous subdivisions.

Dictyonosteus articus is a second Devonian form described by Stensiö; it is represented only by an imperfect ethmo-sphenoid. Its taxonomic position is somewhat uncertain, but as its describer early pointed out, it seems to be of coelacanthid affinities. As far as its structure has been interpreted it agrees well with *Diplocercides*.

The earliest coelacanths appear to show a braincase structure very similar to that of their rhipidistian cousins; the only differences of importance appear to be associated with the presence in coelacanths of a highly developed articular area in the "antotic" region. The two groups have obviously departed but little from a common ancestral type.

Comparison with tetrapods

The structure of the crossopterygian braincase is of major morphological importance in relation to the evolution of the early tetrapods. Watson in 1926 made a number of interesting comparisons despite the unsatisfactory knowledge of crossopterygians which existed at that time. The comparison may now be carried further.

The kinetic peculiarities of the crossopterygian braincase—intra-cranial joint and over-enlarged intra-cranial notochord—are generally assumed to have been absent in the tetrapod ancestors or, if ever present, had been lost before the tetrapod stage had been attained, although it is of interest that in many Paleozoic tetrapods there is a marked zone of weakness and reduction of bony connection between the two regions. In order to facilitate comparisons I have therefore, in fig. 15a, illustrated the *Megalichthys* braincase so modified that these features have been eliminated. The parasphenoid has been extended back to cover the ventral gap and it is assumed that cartilage lay beneath this area about a smaller notochord; the articular areas are assumed to be fused. If kineticism is secondary such a braincase might be fairly representative of that expected in a tetrapod ancestor and perhaps representative of the general stock from which lungfish, crossopterygians and tetrapods have descended.

In comparing with tetrapods, we encounter difficulties in the fact that there are no living tetrapods which can be considered at all primitive in braincase structure. All living amphibians are highly modified in skull structure; indeed even a lizard or *Sphenodon* is closer to primitive conditions in a number of features. For primitive conditions we must turn to the extinct labyrinthodonts. Here we encounter further difficulty in the fact that much of our knowledge of them is derived from rachitomous and stereospondylous forms which, as shown by Watson (1919, etc.), already exhibit specializations similar to those seen in existing amphibians. We are forced to rely upon our knowledge of the carboniferous Embolomeri, as described mainly in Watson's important contribution of 1926. Even here we are hampered by the fact that available material is none too good and in consequence many features of importance are obscure and the internal structure of the braincase is almost unknown.

If the crossopterygian and embolomerous braincases are compared (fig. 15a, c) a striking difference in proportionate size of parts is noticeable. If the basipterygoid articulation, for example, be used as a point of reference, it will be noted that in the crossopterygian this

structure is in front of the mid point of the braincase; in the amphibian it is back nearly three-fourths of the distance from snout to occiput. The same shift backward holds true for the position of the outlets for nerves II and V, the position of the pineal opening dorsally and, internally, the position of the pituitary.

It is obvious that in the amphibian there has been a great elongation of the ethmoid region (rather than the possible converse assumption of posterior shortening). This elongation and consequent disparity of proportions may be interpreted in terms of relative development of brains and jaws.

The elongation of the "face" of early amphibians as contrasted with their piscine relatives is probably related in part to changed food habits and elongation of the jaws, with a necessary elongation of the braincase. In great measure, however, this elongation is probably related to size differences in the forms considered. Crossopterygians investigated are fishes of modest size; the Embolomeri whose braincases are known are mostly far larger.

The results of change of size upon proportions of animals are so obvious that they are usually overlooked (but cf. Watson 1930). If, for example, an animal doubles in length, its necessary food intake is (roughly) cubed, and a disproportionate growth of mouth parts tends to result. On the other hand, it is obvious on functional grounds that brain and sense organs need to increase but little; large animals are proportionately small brained. The brain could not be stretched out to any extent and hence would come to be concentrated in the posterior portion of an elongated skull. There would obviously be a tendency for retention of their original relations on the part of the surrounding skeletal structures. The only place that the braincase could adapt itself to facial elongation would be in front of the brain, in the ethmoid region.

In accordance with these obvious facts I have in fig. 15b diagrammed the *Megalichthys* braincase further modified to show the proportions which might be expected in a long-jawed form of large size. With this change, not only do the various regions fall into line but also the various structural features are clearly comparable.

The nasal capsule region is not preserved in known Embolomeri and was presumably present only in cartilage. The nostrils were widely separated in embolomeres and hence we may assume that the anterior end of the braincase was broad, and narrowed rapidly backward much as in *Megalichthys*. Presumably the anterior end of the palatoquadrate retained an ethmoidal connection here as in *Megalichthys*, antecedent

to the connection of the "pterygoid process" with this region seen in anurans, coecilians and such a urodele as *Menopoma.* The braincase in the ethmoidal region between, roughly, the anterior end of the parasphenoidal rostrum and the optic foramen, is short in the one case, extremely long in the other, but structurally almost identical. In either form there is a narrow ventral edge capped by the parasphenoid. Above the parasphenoid the braincase is for some distance upward essentially an interorbital septum in both forms, although this feature is more pronounced in the more "tropibasic" embolomere than in the crossopterygian. The dorsal part is more expanded in both forms, to contain the anterior end of the endocranial passages, consisting in both of paired tubes anteriorly, converging posteriorly to the anterior end of the brain cavity proper. In the case of the crossopterygian I have assumed that much of the length of these tubes was occupied by the olfactory lobes and even the anterior ends of the hemispheres. In the readjustment of parts correlated with elongation of the skull in amphibians this was probably not the case. Presumably the paired canals were occupied by the olfactory "nerves." This reduction in necessary bulk of the dorsal part of the region has allowed a slimmer development of the septal region.

The primary upper jaws in both types were closely applied, but not fused, to the braincase in the shelf above the parasphenoid at the base of the interorbital septum, a condition which might easily give rise either to a separation and the development of the typical interpterygoid vacuities of amphibians or to the fusion of the adjacent elements characteristic of many reptiles. In the sphenoid region, the basipterygoid process of the amphibian is quite similar to that of the crossopterygian. Both include in their composition not only endochondral bone but also a dermal component from the parasphenoid.

The seemingly lower position of the basipterygoid process in amphibians is to be in part correlated with the expanded notochord back of this region in crossopterygians and consequent differences in the level of the posterior part of the floor of the brain case.

The large opening which Watson interprets as mainly for the optic nerve in Embolomeri lies, as in rhipidistians, ventral to the anterior prolongation of the endocranial cavity; here, however, the reduction of this cavity anteriorly leads to this opening becoming a perforation through the posterior end of the high, thin septum.

Conditions in later types (cf. Watson 1919, fig. 12, *Capitosaurus*) render it certain that the vena capitis lateralis passed backward over the basipterygoid process in embolomeres as in rhipidistians. Watson

notes grooves indicating that the internal carotid curved down and forward around the process to its foramen, as in crossopterygians. The course of the ophthalmic artery and pituitary vein is doubtful;

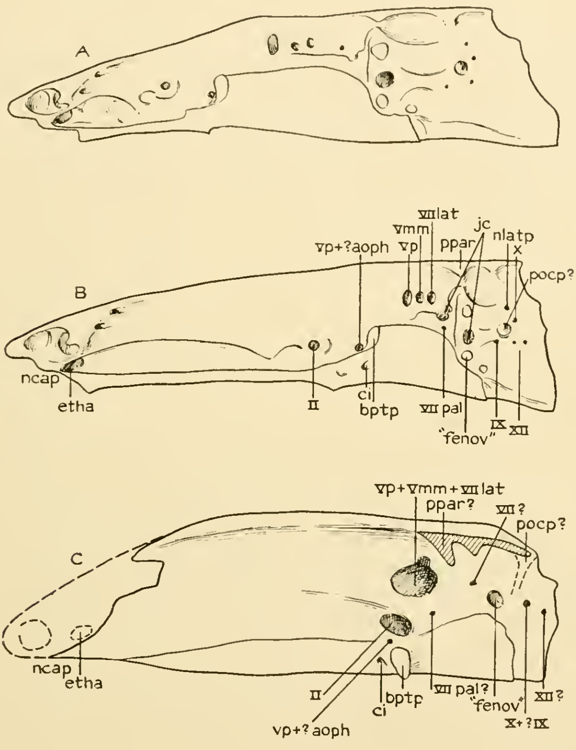

Fig. 15. A, Side view of the braincase of Megalichthys so modified, by the fusion of the two moieties and the extension of the parasphenoid backward over the exposed notochordal area, as to eliminate the kinetic specializations. B, The same, further modified in an amphibian direction, by a change of proportions, to introduce an elongated "sphenethmoid" region. C, Diagram of the side view of a primitive embolomerous amphibian, from Watson's figures and descriptions.

analogy with other lower tetrapods suggests a position in front of the basipterygoid process in a position similar to the foramen which I assume to have carried them in *Megalichthys*. A bar passing backward

and downward between the assumed openings for the optic and trigeminal nerves seems certainly to represent the pila antotica (proötica) which I have termed the laterosphenoid pillar. This marks the posterior termination of the crossopterygian ethmo-sphenoid. Above and below the ends of this bar there is a solid connection of the two halves of the braincase in the position of the upper and lower articulations in the crossopterygian. The ventral gap is covered by the parasphenoid in the embolomeres. It is of interest, however, that in many other early tetrapods, there is an unossified gap in the floor of the braincase in an area comparable to the fenestra ventrally separating the two halves of the crossopterygian structure. Even though the crossopterygian subdivision be assumed to have been absent in tetrapod ancestry, early land vertebrates show a strong development of features which might have led to the origin of such a condition.

In the proötic region a large anterior opening undoubtedly transmitted the entire trigeminal nerve and the superficial ophthalmic; the commisures separating the various components have disappeared, leading to the conditions seen here in most tetrapods. The position of the facialis is uncertain. From the situation in other paleozoic tetrapods, however, I feel justified in assuming that the hyomandibular and palatine rami left the braincase farther posteriorly and gained the surface (as tentatively indicated) in a fashion comparable to that in crossopterygians. The posterior margin of the trigeminal opening is probably the prefacial commisure, and the foramen had not the inclusiveness of the embryonic (and anuran) proötic foramen.

A marked change in the lateral aspect of the otic region is due to the disappearance of the embryonic lateral commissure, the jugular canal and the trough anterior to it, freeing the vena capitis lateralis and the orbital artery (temporal, stapedial) to take an anterior-posterior course lateral to the braincase in the "cranio-quadrate passage." I have elsewhere called attention to the obvious development of the crossopterygian type of hyomandibular into the primitive tetrapod stapes. In this connection it may be recalled that Watson points out that the fenestra ovale had not yet developed in the Embolomeri studied, the point of ventral attachment of the "stapes" still being merely a depression in the outer wall of the braincase, as in crossopterygians.

Watson finds a foramen for the vagus in an appropriate position. He does not describe any openings such as those which I have tentatively assigned to a posterior lateralis nerve and the glossopharyngeal. Possibly, as in modern amphibians, these nerves have gathered into a

common foramen. I have elsewhere noted the possible implications of such a change on the development of the perilymphatic system. The dorsal part of the otic region is poorly preserved in known Embolomeri, and needs careful restudy in other early tetrapods. In consequence I am uncertain as to the fate of the supra-otic fossa and adjoining structures. A seemingly logical assumption is that the parotic process has become the "paroccipital" process found at the back of the labyrinthodont skull, and that this in turn has become the "paroccipital" process of many permo-carboniferous reptiles. I feel, however, none too sure of any of these homologies, and am inclined to believe that the reptilian paroccipital, at least, is a new development from the process to which I have tentatively given this name in *Megalichthys*. Further data is needed.

The occipital regions seem fairly comparable in the two groups. The hypoglossal opening has not been identified in embolomeres as yet, but its presence in other early amphibians makes it certain that was present here, as in *Megalichthys*, but presumably with a single external opening. There is little development of a true condyle in *Megalichthys*, the major connection with the column being afforded by the notochord itself. It is easy, however, to see how the single large circular condyle of the primitive amphibian developed with the reduction of the notochord.

The roof of the braincase is in both cases unbroken by foramina except that for the pineal. In the crossopterygian this opening is far forward; in the embolomere far toward the back. This seeming contrast, however, is correlated with the changes in proportions noted above; it is not so much a backward movement of the pineal as an elongation of the region anterior to it.

In this connection brief comment may be made concerning the homologies of the roofing bones in the two cases. I have recently (1936) tended to take the despairing attitude that it is perhaps impossible to make positive comparisons between the two groups; but the obvious similarities here noted in the case of the braincase gives renewed hope.

A stumbling block in the identification of the important median longitudinal elements lies in the seeming contrast in the position of the pineal opening in the two cases. In tetrapods it lies far back between the definitive parietals; in crossopterygians far forward between the bones generally identified as frontals. Morphologists have been in general loath to believe that the foramen would change its position relative to the dermal elements. Save-Soderberg has recently (1935)

attempted to account for the seeming shift by a complicated cutting apart and pasting together of fragments of the elements of this region, for which there is little evidence. The writer (1936) pointed out that the "extrascapulars" of crossopterygians are not homologous with the dermal supraoccipitals of amphibians, with which they have been generally correlated; but this only seemed to make the problem more difficult of solution.

A ray of light on this seemingly difficult situation is the recent suggestion of Westoll (1936), which he promises to elaborate in a future paper, that the elements concerned with the pineal in the two cases are actually the same; the "frontals" of the fish are equivalent, in part, at least, to the true parietals. At first sight this seems highly improbable, for it leaves the large "parietals" of the fish as homologues of the comparatively small dermal-supraoccipitals of the tetrapod. But in the light of the history of the braincase it seems that Westoll's solution is the correct one. The differences in seeming position of the pineal and true parietals are not absolute but in the main relative and due to differences in length of the facial region. Anterior elongation would reduce the supposed fish "parietals" to reasonable comparative size, and we may assume further that these true dermal-supraoccipitals have begun the process of reduction which eventually resulted in their disappearance from later tetrapod skulls.

Comparatively little is known of the internal structure of the embolomere braincase. A few points concerning the matter have been mentioned earlier. The pituitary fossa, in the absence of the large crossopterygian notochord, is of "normal" construction, with an overhanging sella. The general agreement of the internal soft parts of crossopterygians with those of modern amphibians suggests that in general the cavities containing these structures in embolomeres may have been comparable to the crossopterygian structure. I have previously commented on the seeming contrast in the mode of exit from the brain cavity of the posterior branch of the auditory nerve and of the glossopharyngeal.

Apart from the kinetic features—intracranial joint and large notochord—the crossopterygian braincase is not only a possible morphological ancestor of that of the embolomere, but approaches the latter closely in many features. To convert the one into another we need only assume: (1) elongation of the ethmoid region, (2) loss of the jugular canal, (3) fusion of nerve exits in a few cases.

Comparison with Dipnoans

In the following comparisons with various fish groups, as was the case with tetrapods, it will be assumed that the chondrocranial subdivision and large notochord of the known crossopterygians are secondary characters which will be disregarded for comparative purposes.

It is unquestionable that crossopterygians and lungfish are allied stocks. But comparison of their endocranial structures is difficult. Part of this is due to the marked contrast in jaw structure and articulations. But further difficulties are due to the fact that living lungfish have surely departed widely from the ancestral types in braincase structure, as they are known to have done in the case of their dermal skeleton. Of older dipnoans we know as yet only an incomplete braincase of *Dipterus* described by Watson and Day (1915); a promised description of a second paleozoic braincase by Stensiö will be awaited with interest.

The posterior region of the modern lungfish skull, with its incorporation of numerous vertebral elements and the enormous backward expansion of the parasphenoid, is particularly difficult to compare with that of a crossopterygian. Here, however, Watson and Day's work indicates that early conditions were similar. Their figure of the ventral surface of the occipital region of *Dipterus* shows a condition in the aortic grooves, etc., highly comparable with a crossopterygian. Their description of the remainder of the post-otic region reads almost exactly like a description of the occipital region of *Megalichthys*.

The condition in the orbitotemporal and otic regions, as interpreted on embryological grounds, is basically different in structure. There is no outer wall (lateral commissure) in the parotic region. Instead the region is enclosed laterally by an otic process of the palatoquadrate which, however, in the embryo serves the same functional purpose of enclosing a "cranio-quadrate passsage" the contents of which (vena capitis lateralis, orbital artery, hyomandibular VII) are exactly those of the jugular canal of *Megalichthys* (or *Acipenser*). There is, of course, no floor to the passage; but here again there is analogy to the structure of the jugular canal in the embryonic *Amia* before the formation of the post-palatine commissure.

In later embryonic and larval life there occurs a great further development of cartilage in the area from the otic ramus of the palatoquadrate back along the outer surface of the otic region. Not

only does the "cranio-quadrate passage" become floored, but its elements are separated; hyomandibular VII is far removed at its outlet from the artery and vein; the orbital artery and internal carotid are enclosed by cartilage back beyond their point of division, along the dorsal aortic channel; the vein not only has a separate channel through the region comparable in position to the jugular canal, but is almost completely enclosed by cartilage to a point behind the vagus; and the vagus (except for lateralis components) is completely enclosed to a point below its crossing the head vein.

In the orbital region there are further contrasts associated, again, with the fusion of palatoquadrate with braincase. A solid attachment is found between the two elements not only at the site of the basipterygoid process but also by a bar running dorso-ventrally external to the profundus and head vein. Although jaw and braincase arise as a unit in *Lepidosirien* and *Protopterus* (Agar 1906) and fuse at a very early stage in *Ceratodus*, this bar is interpreted as pertaining to the palatoquadrate (as an ascending process) rather than to the chondrocranium (as a pila lateralis).

Anterior to the basipterygoid region, palatoquadrate and trabeculae are indistinguishably fused.

Internally the endocranial cavity, nerve exits and otic region are quite similar in the two groups; the writer's restoration of the nervous system as inferred from its cavities, for example, are closely comparable with Pincus' description of Protopterus (1895).

If we attempt to reconstruct the skull of a common ancestor of a dipnoan and a crossopterygian, a major concern is with the relations of palato-quadrate and braincase.

First, is the "autostyly" of the dipnoan primary or secondary? To this question the orthodox answer is that it is secondary and we will, for the moment, assume that this answer is correct and that movable articulations were present in the common ancestor. A basal articulation would certainly have been present and the close apposition of jaw and braincase in the ethmoid region of the crossopterygians could readily change to the fusion seen here in the lungfish.

The dipnoan palatoquadrate is further attached to the skull by otic and ascending processes. No such articulations are present in rhipidistians. They are present in modern amphibians. There, however, these attachments are surely secondary, as is shown particularly by the work of Watson (1919) and Sushkin (1927); the palatoquadrate lies close to the braincase at these points in embolomeres and fusion follows. Since the crossopterygian palatoquadrate has a similar rela-

tion to the braincase, it is possible to imagine that the dipnoan connections are likewise secondary.

But an "otic" connection of palatoquadrate with braincase is found in early shark types and the chimaeras. Hence this may well be a primitive vertebrate character, present in the common ancestors of lungfish and crossopterygians and lost in the latter. If so, it would be expected that in this common ancestor the parotic process would have had an expansion of the lateral commissure forward anterior to the spiracle for this attachment; essentially a postorbital process. This development would necessarily imply that the jugular canal reached farther forward than in known crossopterygians and that instead of an open "temporal" region there would have been a structural arrangement highly comparable to the jugular part of an actinopterygian trigeminofacialis chamber; here more properly a trigeminal chamber, since the facial nerve would probably have been embedded in the posterior wall.

The articulation of the ascending ramus, however, may be reasonably interpreted as secondary. It is unknown in fishes apart from the forms here discussed and is surely secondary in tetrapods. In crossopterygians it is present in the coelacanths. But since it appears to be a progressive development, and since the basipterygoid attachment disappears in the course of this development, it is reasonable to assume that we have the replacement of an old ventral attachment by a new dorsal one.

I have noted that the *Ceratodus* braincase is more expanded laterally in the otic region than is the case in crossopterygians, so that it more fully encloses the various nerves and vessels. This may be secondary; but (as noted below) the great degree of development seen here in a number of other fish types suggests that the condition in *Ceratodus* is essentially primitive.

From the above discussion of dipnoans we may postulate that the chondrocranium in a form antecedent to known crossopterygians would, if found, differ from them in the absence of the kinetic mechanisms, the presence of an "otic" articulation of the palato-quadrate, the presence of a trigeminal chamber, and probably a greater development of the region lateral and ventral to the otic capsule.

It has become increasingly apparent during the past decade that a great phylogenetic cleft divides the "higher" fishes into two groups, the actinopterygians on the one hand, lungfishes and crossopterygians on the other; with the latter would of course be included such hypothetical and hoped for creatures as that just described and the actual

ancestor of the tetrapods, structurally approached but not attained by the rhipidistians. For this group I know of no appropriate term. Tate Regan (1928) has used Crossopterygii for these forms; but this is too wide an extension of a familiar term. Säve-Söderbergh (1934, 1935) has proposed the term Choanata as that of a super-class (?) to include these forms and their tetrapod descendents as part of a phylogenetic scheme of rather unusual character. The term is hardly necessary in any phylogenetic and taxonomic scheme for which there is adequate support, although it is highly useful in a more "popular" sense, comparable to "tetrapod," "amniote" etc. To cover the piscine members of this category, I propose the related term Choanichthyes. The classification of the gnathostome fishes would thus be as follows:

Class Placodermi
Class Chondrichthyes (Elasmobranchii s. l.)
Class Actinopterygii
Class Choanichthyes

The relations of the first two groups may be a matter of debate for many years to come.

Comparison with Actinopterygians

Since the actinopterygians are a group widely divergent from the choanate fishes, it would be expected that they would possess many features unconnected with the earlier history of the choanate stock. Under this category would come the myodome and the associated structural modifications. Apart from these, however, they exhibit a number of characters similar to those seen in the crossopterygians and give many suggestions as to the earlier nature of the ancestors of the Choanichthyes.

Far more primitive than any of the existing higher actinopterygians are the carboniferous palaeoniscids in which the braincase has been described by Watson (1925). The myodome was already developed, and the characteristic high thin interorbital septum of the actinopterygians present; as Watson points out these features are obviously divergencies from primitive conditions related to the sensory dominance of the eyes. The pila proötica, lost in more advanced members of the class, was still present. A basal articulation with the palatoquadrate is found in Watson's material; this is lost in almost all later types, except *Lepidosteus*. Neither in these nor in any other known actinopterygians is there any "otic" articulation; the loss of this connection, surely a primitive one, is to be associated with the develop-

ment of hyostyly. There is no ventral articulation of the hyomandibular; presumably a reduction associated with function. The original area of "otic" palatoquadrate attachment seems clearly marked out by the large postorbital process, so greatly expanded that it surrounds the spiracular area to form a canal. There is a highly developed trigeminofacialis chamber with an associated jugular canal, forming an arrangement such as I have pointed out would be expected in an ancestor of the choanate fishes.

The posterior part of the braincase is highly developed. The head vein is not enclosed to the extent seen in *Ceratodus,* although it is overhung by a ridge rather as in *Megalichthys.* On the other hand, the ventral surface is more developed, enclosing within its substance much of the dorsal aorta. It is of interest that in Watson's carboniferous material there is no subdivision of the completely ossified braincase; presumably a primitive condition.

Despite the undoubtedly wide separation of the two higher fish stocks, it will be seen that they exhibit fundamental similarities. Indeed, the structure deduced earlier for the braincase of a choanate ancestor would seem essentially to have been that from which the actinopterygian braincase might have been derived as well. If we assume the development of large eyes and jaw suspension by the hyomandibulars the remaining actinopterygian specializations follow as a logical consequence.

Comparison with shark-like fishes

If we attempt to trace the history of the choanate braincase downward into the lower gnathostomes, we gain little satisfaction from modern sharks and rays. The braincases in these forms is markedly different from that expected in an ancestor of the Choanichthyes, or of an actinopterygian for that matter. The differences lie not merely in the widely different proportions but in many structural features, such as the absence of a functional basal articulation of the palatoquadrate and the almost universal absence of an otic articulation, the absence of a trigeminofacialis chamber and of a jugular canal (except for a slight development of this sort in *Squalus*) and, in general, the comparatively "undeveloped" state of the braincase so that many of the blood vessels and nerves which in bony fishes are frequently enclosed in bony channels are here free from the braincase or enclosed only to a slight degree. Indeed, the chimaeras, despite their speciali-

zations, afford a more satisfactory basis for comparison, since both basal and otic palatoquadrate connections are present.

Among paleozoic sharks, however, we meet with better success. I have been engaged for a number of years in the study of the braincase of permo-carboniferous pleuracanths. Unfortunately the work is as yet unfinished and I have published but a few incomplete and diagrammatic figures (1933). In these sharks there is a well developed "postorbital" process, enclosing an area which is essentially a trigemino-facialis chamber, and pierced by the structures which constitute the contents of the jugular canal or "cranioquadrate passage;" the palato-quadrate (as has long been known) articulates with this process; the ventral surface of the braincase encloses a long reach of the dorsal aorta, etc. So different were these forms from modern sharks that I have been forced to compare them with bony fishes instead for an interpretation of their structure, although it was impossible that there should be any close connection between pleuracanths and "higher" fish types.

It was therefore pleasing to me to see the recent preliminary account by Stensiö (Holmgren and Stensiö 1936) of his findings in a *Cladodus* specimen from Wildungen. The material is fragmentary (for example, the skull was probably more elongate than his restoration would indicate) but shows a condition almost exactly like that in pleuracanths. It is evident that we are dealing here with a braincase form which was widespread among early sharks.

We have here, then, a type of shark skull which comes fairly close to the type inferred as ancestral to later bony fishes. But we are not yet at the meeting point of these varied lines. There is in these forms no basipterygoid articulation, for example, although the chimaeras show that such an articulation can exist in the chondrichthyes. Further, all trends in modern work on fishes, particularly that of Stensiö, indicates that the common ancestors would have had an ossified braincase and a roof of dermal bones, whereas these types have cartilaginous (although well calcified) braincases and there is no positive evidence of any roofing bones in cladoselachians or pleuracanths. These forms are primitive sharks, but they are definitely on the shark side of the bifurcation; degeneration has been initiated.

A further step downward is seen in *Macropetalichthys*, in which the braincase has been described by Stensiö (1925); as shown by the postcranial skeleton this form is a shark. Its skull structure, although at first glance seemingly grotesque, can readily be interpreted in terms of pleuracanths and cladodonts on the one hand and the hypothetical

ancestor of the higher fish groups on the other. The orbit is confluent with a trigeminal chamber. A huge lateral process may well have served as the point of attachment for an otic ramus of the palatoquadrate as well as the hyomandibular. The elements of the jugular canal group traverse this long process as in pleuracanths and cladodonts and the rest of the head vein is partially concealed. The aortic region is buried beneath the bone or, posteriorly, lodged in a deep groove. There is no definite evidence of a basal articulation; but it will be noted that there is a reasonable point of articulation at a point beneath a "preorbital process" which is at one and the same time ethmoidal and basal in position. The basal articulation may have evolved as an "emphasized" posterior termination of a once single articular area between future ethmoid and basipterygoid regions of attachment, the separation taking place in relation to elongation of the "sphenethmoid" region. As indicating the probability of this, it may be noted that the palatoquadrate is continuously in close contact with or fused to the braincase between these two regions of attachment in forms as far apart as chimaeras, lungfish, crossopterygians, embolomeres and even *Scymouria.*

Finally and most important is the fact that in *Macropetalichthys* the braincase is ossified and is roofed with dermal bones. We have thus travelled back to the stage in the development of skeletal materials to be expected in the common ancestor of all living jawed vertebrates.

I do not claim that *Macropetalichthys* and his relatives are the actual ancestors of later vertebrates; the acanthodians, for example, when better known, may prove to be even more generalized and primitive. But it is, I think, clear that in braincase structure *Macropetalichthys* is very close to conditions expected in such a common ancestor.

In this connection I wish to protest against the frequent assumption (as in Holmgren and Stensiö 1936, pp. 324–335, DeBeer and Moy-Thomas 1936, p. 309, etc.) that the presence of certain structural features in *Macropetalichthys* argues for their being structures characteristic of arthrodires, and particularly the assumption that similarities between *Macropetalichthys* and sharks indicate a close relationship between arthrodires and sharks. These assumptions rest upon the premise that *Macropetalichthys* is an arthrodire; this premise is contrary to the known facts (Heintz 1932).

Until recent years this devonian fossil was regarded as an arthrodire for the reason that it possessed a bony skull roof. The presence of such a structure in a shark was contrary to theories of vertebrate evolution then prevalent and *Macropetalichthys* was disposed of by including in

the arthrodires, although there was no positive ground for such inclusion. This belief was still prevalent when, in 1925, Stensiö wrote his excellent paper on the braincase of this fish and he was hence justified at the time in using *Macropetalichthys* as a basis for arguing that arthrodires were closely related to sharks.

In 1933 the writer in his "Vertebrate Paleontology" took the (then) bold step of removing this form from the arthrodires and placing it among the sharks (in a broad sense), using Smith Woodward's term Stegoselachii to cover provisionally this and other primitive sharks in which dermal elements were still present. This step was almost immediately justified by Broili's discovery (1933) of Macropetalychthyids in which the body was preserved; these showed that the entire skeleton was almost typically shark-like, and not arthrodian in nature. *Macropetalichthys* cannot be included in the Arthrodira or the broader group, Placodermi, without stretching these terms to an unwarranted degree. Unquestionably placoderms and sharks (Elasmobranchii, s. l.= Chondrichthyes) have a common ancestor, and presumably the arthrodires and other placoderms, although aberrant, have retained many primitive features to be expected in a shark ancestor. But *Macropetalichthys* cannot be used as an argument on the placoderm side of the question; it is definitely a shark, while the typical arthrodires go back to a primitive stock, described especially by Heintz (1929), much closer to the antiarchs and indicating a pedigree widely divergent from the *Macropetalichthys* shark group.

Notes on Early Gnathostome Cranial History

As noted earlier, consideration of the phylogenetic history of the fish cranial region on embryological grounds leads to the assumption that a cartilagenous condition of the skeleton was a primitive one; further that the original chondrocranium was a simple structure and separate from the jointed jaws and other visceral arches; complexity of structure and fusion of parts are assumed to be secondary.

Any inquiry, such as the present one, into the pedigree of a fish skull type, leads to almost diametrically opposite conclusions if modern paleontological research be kept in mind.

In the first place, the work of both Watson and Stensiö has made it clear that in most instances a cartilagenous condition of skeletal parts is secondary. The latter, particularly, has shown the widespread occurrence of endochondral as well as dermal bone among the oldest verte-

brates. That a bony structure is to be expected in an ancestral gnathostome is a thesis which I feel to be so firmly established that I have accepted it in the preceding discussion without question.

Secondly, primitive vertebrates were not simple in cranial structure, but as complex as, or more complex than many of their descendants. In the days when paleontology was in its infancy, morphologists fondly evolved hypothetical ancestral forms to fill the gaps between living groups, "archetypes" of simple and diagrammatic structure. Today many of these gaps are filled by actual fossils. But these are never the simple types imagined; often they are quite the reverse, showing many unexpected quirks in structural evolution.

So in the present case. In the search for a cranial type ancestral to that of crossopterygians, we have found no simplicity. The comparatively simple and "undeveloped" modern shark braincase shows little resemblance to that of bony fishes; the more complex, more "expanded" type of older sharks is much more similar.

It is obvious, I think, that the primitive gnathostome braincase was developed to a degree almost unknown in modern forms, to include within its substance many structures usually external to it. Neglecting many details, these inclusions were of two sorts.

1. The dorsal aorta and related structures were probably enclosed in the base of the braincase from the internal carotoid region back into or beyond the aortic arch region.

2. The jugular vein was probably enclosed in a canal all along the side of the skull from the orbit to a point opposite the occiput. The anterior opening of this canal would be the primitive trigeminus chamber; back of this the jugular canal is the remnant of an originally longer structure. The orbital artery would have traversed this canal in its anterior part, and not only V and VII, but nerves IX and X may have opened into this cavity; it would have been essentially an elongated "cranio-quadrate passage."

While for purposes of simplification I have spoken of a common canal for these structures, it is more probable, from the "shark" evidence, that vein, nerve and artery were actually separately enclosed, although adjacent; the nerves may have emerged close to but not in continuity with the vein canal, and the orbital artery (as is often the case) likewise may have occupied a separate but adjacent canal.

With regard to visceral arch articulations, the *Megalichthys* double dorsal and ventral attachment of the hyomandibular leads to interesting possibilities. I assume that this is primitive. The argument of the

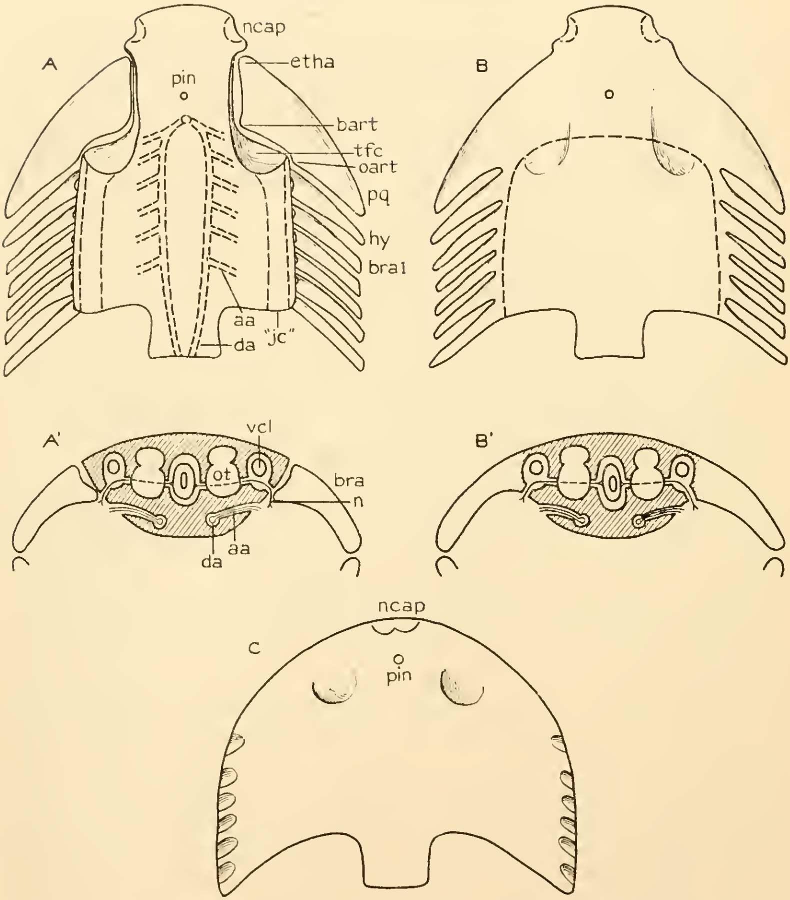

Fig. 16. A series of possible stages in the early history of the vertebrate skull, in descending order. A, diagram of hypothetical primitive shark in which branchial arches and jaws articulate with the braincase dorsally and ventrally, an expanded "jugular canal" region extended backward along either margin of the braincase from a primitive "trigemino-facialis chamber", and the anterior end of the aorta and related vessels were enclosed on the under side of the braincase. A¹, cross section of the same, through the otic region. B, the same figure so modified as to suggest an earlier "autostylic" condition with all visceral arches fused with skull. The broken line indicates the division between skeletal materials of "visceral" (neural crest) origin and normal mesoderm. B¹, cross section. Axial mesodermal area shaded. C, still further modification of the same with shortening of the trabecular region and further fusion of the branchial arches, in a condition comparable to that of ostracoderms.

previous section suggests that in a primitive gnathostome there were two palatoquadrate articulations; an anterior ventral one with the trabecular region, from which later ethmoid and basipterygoid articulations arose, and one postero-dorsally with the combined postorbital and otic process. These two attachments are comparable to those of the hyomandibular. Can a similar situation have held farther back? There is evidence suggesting, although not at all proving, that primitively the branchial arches were attached to the side of the braincase by double dorsal and ventral articulations (cf. Schmalhausen 1923 and Sushkin 1927, the latter citing Woskoboinkoff).

I have, in fig. 16a, shown in diagrammatic and vastly over-simplified fashion, the conditions which may have prevailed in an early gnathostome. As noted previously, *Macropetalichthys* shows essentially the braincase characters suggested; there is little paleontological evidence regarding the visceral arches.

A further theoretical step downward in skull history concerns the attachment of the visceral arches to the skull. It is generally assumed, particularly by those approaching the subject from the embryological side, that the jaws, and presumably the other arches, were without question separate elements in primitive vertebrates (cf. for example, de Beer and Moy-Thomas 1935, p. 307, footnote), and that a fused autostylic condition of the jaws is secondary.

There is however a great amount of evidence which points in the other direction. The fusion of jaws and braincase in amphibians is certainly secondary. On the other hand, as we have noted, the dipnoan situation is less clear cut, and in the chimaeras jaws and braincase are a unit at this first appearance; there is no evidence of a secondary condition. Further Moy-Thomas (1936, etc.) notes that sharklike forms with fused jaws were common in the Paleozoic, in contrast with their subsequent rarity. There are certainly strong suggestions that in primitive gnathostomes a fused condition of the upper jaws was a general, and not improbably a really primitive condition. Some, if not all, of the modern forms with this type of jaw support may be secondary; but this "reversion" may be readily explained by a return to paths of embryonic development not long abandoned (even the amphibians, it will be noted, were "reverting" by the beginning of the Permian).

If Agnathous forms be considered the evidence for a primitively fused cranial structure is overwhelming. In living cyclostomes the visceral apparatus, except for the specialized "tongue" is solidly united. And, finally and most conclusively, Stensiö's splendid work of 1926 on

the cephalaspids has logically forced him to adopt without question the thesis that the primitive condition in vertebrates was one in which visceral arches, braincase and dermal covering formed a single solid structure.

One may be justified, therefore, in assuming that in a primitive gnathostome the upper jaws and upper ends of the other arches were fused to the skull, as shown in diagram in fig. 16b.

In cross section (fig. 16b′) I have shaded the braincase component of the fused mass, in contrast to the visceral arch portion. In such a solid structure the line of demarcation, being of no functional importance, might vary somewhat. This leads to interesting theoretical possibilities. For example, if the separation in the region of the otic process of the palato-quadrate took place at the point indicated in the diagram, there would remain on the braincase a lateral commissure enclosing a jugular canal and forming the lateral wall of a trigeminal chamber. If the line of division between embryonic visceral and axial components were slightly more medial, these structures would be absent from the braincase and the outer wall incorporated in the palatoquadrate; the enclosure would be an antrum petrosum lateralis, rather than trigeminal chamber and jugular canal. DeBeer (1926, p. 359 f. f.) is correct, on embryological grounds, in criticising Allis' comparison (1914) of the "antrum" of *Ceratodus* with the "chamber" of Actinopterygians. But under the hypothesis here entertained the two cavities may be phylogenetically identical, and Allis' comparison essentially sound.

In the dorsal view of the hypothetical fused stage discussed, the broken line indicates, laterally, the division between arch and braincase components; anteriorly this line crosses the braincase at the level of the division between the trabecular and parachordal regions of the skull. This is in accord with the findings of Platt and Stone, noted earlier, dividing the cranial mass into its two embryological components. The trabecular region arises like the visceral arches from neural crest material, while the posterior part of the braincase arises in "normal" fashion.

This embryological division of the early braincase leads to a final hypothetical suggestion with regard to early vertebrate cranial history. All lines of evidence suggest that the anterior region of the head—this visceral, trabecular region—has been elongated during the phylogenetic history of vertebrates. Much of the evidence has to do with skeletal structures; but there is, as is well known, a great array of material concerning the pituitary complex which can only be explained by such

a process; while the history of the brain is best explained on the assumption of a gradual forward expansion of the forebrain.

With these facts in mind, I have ventured, in fig. 16c to further modify my diagrammatic skull by shortening the anterior part of the visceral region. With this shortened state might reasonably be associated a coalesced condition of the nasal sacs and various modifications of associated internal structures.

In such an assumed stage we see a cranial pattern which in its proportions might well have been that of the less specialized lower Devonian arthrodires (cf. Heintz 1929, etc.), whose internal structure is as yet unknown.

Finally, we have here a theoretically basic gnathostome stage which is not separated by any great or unbridgeable structural gap from the known ostracoderms.

Even such a seemingly specialized type as *Cephalaspis* shows many resemblances to my hypothetical prognathostome. The anterior visceral region—the "snout"—is differently developed in the two cases, nostrils and hypophysis being situated dorsally in Cephalaspids; at present the primitive conditions here cannot be deduced with certainty. I have not attempted to interpret the ventral aspect of the visceral region. But in general contours there is a marked similarity, and reference to Stensiö's figures will show that although the internal structure of cephalaspids is, of course, highly complex, the situation of the main arteries, the main head veins and the proximal portions of the nerves is fundamentally similar to that which I have deduced for a gnathostome ancestor. Possibly the anaspids, if their internal structure were known, would be even closer, for they obviously lacked such specializations as the presumed electric fields of the Osteostraci.

To sum up in ascending rather than descending order, I assume the major stages in cranial evolution to have been as follows:

1. An agnathous stage with arch and braincase components fused to one another and to the overlying dermal roof, as postulated by Stensiö and as represented in great measure by anaspids and cephalaspids.

2. A primitive gnathostome stage, in which the lower halves of the jaws and other arches were movable, the upper halves still fused, the anterior visceral region of the skull and jaws still short. This stage presumably represented in a general way by the lower Devonian arthrodires.

3. A primitive "shark" in which the anterior portion of the skull (and jaws) have elongated; the visceral arches perhaps freed from the braincase but the upper jaws still fused and a dermal skull roof re-

tained. Represented, except that the palatoquadrate has been freed, by such an shark as *Macropetalichthys* and possibly the acanthodians, were these forms better known.

5. Subsequent to this stage began the differentiation of the later fish groups. Almost universally the palatoquadrate becomes freed from the braincase; the originally broad and deep braincase tends to contract, releasing to the surface many of the structures originally embedded in it; the originally solidly ossified braincase tends to break up into separate elements or, as in many "higher" types as well as sharks, to degenerate to a cartilagenous structure; in sharks the dermal roof is lost.

In the theory of vertebrate skull evolution advanced above there is little actually new; many of the suggestions made here have already been advanced by other workers and all the elements of this assumed sequence are indicated by modern work on paleozoic fishes. I have not attempted to work out the full story of possible structural developments, and have confined myself to a few major features. In attempting to illustrate the evolutionary story by simple diagrams, I have laid myself open to the criticism which may be made of all "archetypes," for surely even the most primitive vertebrates (as illustrated in cephalaspids) were highly complex. The theory advanced will undoubtedly prove to be incorrect in many details, not improbably in many major features. But I have, at least, attempted to erect a working hypothesis which is far more consistent with the known paleontological facts than those based primarily on embryology which are now current.

SUMMARY

The braincase of *Megalichthys* is described in some detail, and a restoration of the cranial nervous system, internal ear and certain parts of the vascular system attempted. These soft parts appear to be comparable to those of dipnoans on the one hand and amphibians on the other. *Megalichthys* appears to be representative of the rhipidistian crossopterygians in braincase structure. Except for "kinetic" features the crossopterygian braincase is a reasonable morphological antecedent of that of primitive tetrapods and shows a close approach to tetrapod conditions in such features as (for example) the hyomandibular (=stapes).

In Dipnoi and Crossopterygii the braincase is reducible to a common pattern. The class term Choanichthyes is proposed to cover these two

groups and hypothetical related types. A search for the antecedents of the Crossopterygian braincase leads to the conclusion that in the primitive devonian shark *Macropetalichthys* we have a form morphologically ancestral in braincase structure to both sharks and all "higher fishes." Consideration of fish history suggests that in the primitive gnathostome the braincase was a highly expanded structure to which the upper ends of visceral arches were attached. Such a condition in great measure bridges the structural gap separating gnathostomes from the older jawless ostracoderms.

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EXPLANATION OF ABBREVIATIONS USED IN FIGURES

For many portions of the nervous and circulatory system the same abbreviation may represent both the structure and foramina or canals containing it.

aa	Dorsal end of aortic arches.
aca	Ampulla of anterior vertical semicircular canal.
ace	Ampulla of horizontal semicircular canal.
acp	Ampulla of posterior vertical semicircular canal.
aop	Optic artery.
aoph	Ophthalmic artery.
aor	Orbital artery.
ap	Palatine artery.
bal?	Probable point of attachment of first branchial arch.
bart	Basal attachment of palatoquadrate to skull.
bptp	Basipterygoid process.
bra1	First branchial arch.
ca	Anterior vertical semicircular canal.
ccom	Crus commune of utriculus.
ce	Horizontal semicircular canal.
cer	Cerebellum.
cfa	Canal reprsenting foramen apicale.
ch	Cerebral hemispheres.
ci	Internal carotid artery.
clat	Lateral commissure.
cot VII	Canal carrying the hypotic ramus of facial nerve.
cp	Posterior vertical semicircular canal.
cpref	Prefacial commissure.
da	Anterior end of dorsal aorta.
daa	Dorsal process articulating with otico-occipital.
dap	Cup to receive articular surface of ethmo-sphenoid.
dper	Perilymphatic duct.
ds	"dorsum sellae" between pituitary and anterior notochord attachment.
en	Position of external naris.
endc	Endocranial cavity.
etha	Pocket forming ethmoidal articulation with palatoquadrate.
fa	Foramen apicale.
fbc	Basicranial fenestra.
"fenov"	Position of future fenestra ovale.
fm	Foramen magnum.
fr?	Possible homologue of fenestra rotunda.
ga	Groove for lateral aorta.
gh	Habenular ganglion.
gj	Groove marking course of "jugular" vein.

gll	Groove underlying lateral line.
hy	Hyoid arch.
hyp	Hypophysis.
hmd	Dorsal articulation with hyomandibular.
hmv	Ventral articulation with hyomandibulae.
inf	Infundibulum.
jc	Jugular canal.
"jc"	Hypothetically expanded jugular canal area.
jca	Anterior opening of jugular canal.
jcp	Posterior opening of jugular canal.
jt	Trough in temporal region occupied by head vein.
l	Lagena.
lo	Olfactory lobe.
lt	Position of lamina terminalis.
mb	Macula of pars basilaris.
mn	Macula neglecta.
ms	Ridges indicating speta between muscle segments on occiput.
msc	Mesencephalon.
msl	Maculae of sacculus and lagena.
my	Utricular macula.
na	Nutrient artery.
nc	Position of notochord.
ncap	Nasal capsule.
ncm	Medial "pocket" in nasal capsule.
nlatp	Posterior lateralis nerve.
nve	Small foramina furnishing blood supply to ethmoid shield.
oa	Occipital artery.
oart	Otic (dorsal) attachment of palatoquadrate to braincase.
oca	Occipital arches.
ocap	Otic capsule.
ol	Optic lobes.
onc	Orbito-nasal canal.
orbc	Orbital (sphenolateral) cartilage.
pant	Pila antotica (proötica).
parch	Parachordal.
pas	Parasphenoid.
pcart	Polar cartilage.
pcp	Posterior chorioid plexus.
pin	Pineal region.
pit	Pituitary fossa.
pl	Laterosphenoid pillar.
pocp?	Possible homologue of paraccipital process.
ppar	Parotic process.
pq	Palatoquadrate.
rcom	Ramus communicans n. VII–X.

s	Sacculus.
send	Endolymphatic sac.
sof	Supraotic fossa.
sofen	Fenestra between temporal and supraotic regions.
sot	Saccular otolith.
spso	Location of spiracular sense organ.
svom	Venous sinus beneath brain draining into middle cerebral.
t	Tubercles presumable for branchial arch muscles.
tfc	Primitive trigemino-facial chamber.
tmarg	Tanenia marginalis.
trab	Trabecula.
u	Utriculus.
uot	Utricular otolith.
vaa	Ventral process articulating with otico-occipital.
vap	Groove for articulation with ethmo-sphenoid.
vcm	Middle cerebral vein.
vdac	Dorsal tube presumable carrying vein or lymphatic from ear to cavity of posterior lateralis nerve.
vj	Anterior end of trough carrying vena capitis lateralis.
vmd	Small dorsal vessels in cerebellar region.
vp	Pituitary vein.
vpr	Small veins penetrating braincase from temporal region.
I	Olfactory nerve.
II	Optic Nerve.
III	Oculomotor nerve.
IV	Abducens nerve.
Vmm	Maxillary and mandibular rami of trigeminus.
Vp	Profundus nerve.
Vp2	Canal in nasal region for profundus nerve.
VIIhm	Hyomandibular ramus of facial nerve.
VIIlat	Anterior lateralis nerve.
VIIos	Superficial opthalmic nerve.
VIIos2	Canal in lateral ethmoid region for superficial ophthalmic nerve.
VIIpal	Palatine ramus of facial nerve.
VIIot	Hypotic ramus of facial nerve.
VIII	Auditory nerve.
VIIIra	Anterior ramus of auditory nerve.
VIIIrp	Posterior ramus of auditory nerve.
VIIIrsl	Ramus of auditory nerve to sacculus and lagena.
IX	Glossopharyngeal nerve.
X	Vagus nerve (less lateralis component).
XII	Hypoglossal nerve.

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THIRD LIST OF ANTILLEAN REPTILES AND AMPHIBIANS

By Thomas Barbour

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No. 2. — *Third List of Antillean Reptiles and Amphibians*

By Thomas Barbour

INTRODUCTION

I published a Second List of Antillean Reptiles and Amphibians in 1935 (Zoologica, **19**, no. 3). Since that time much new information has accumulated. I have, therefore, prepared a third list, departing from the general custom not always consistently followed, of designating all or most island forms binominally. The practice of using trinomials for races that are obviously closely related has become so general, that I present herewith some attempts to show relationship in this way. There have been many groups in which I have not yet felt that our knowledge is complete enough to do this, and these I have allowed to stand as in the previous lists, simply bringing the information concerning distribution up to date.

Doctor Charles Schuchert in his noteworthy Historical Geography of the Antillean-Caribbean Region (New York, John Wiley & Sons, 1935, pp.I–XXVI and 1–811) writes on page 107 as follows:

The writer agrees with Barbour and others that the Antillean faunas are too homogeneous throughout, and have too many phyla with delicate organisms, to have reached the islands by flotsam and jetsam dispersal. On the other hand, very few species are now common to Antillia and Central America, and this means long isolation.

"The time of the older migration is best seen in the snails, which have had a long and prolific evolutionary history, with a vast specific and generic differentiation. They can not be drowned out during submergences so long as there are islands left, and probably more islands existed than the paleogeographic maps show. Pilsbry thinks that the snail faunas of the Greater Antilles are certainly as old as the early Eocene and probably go back as far as the Cretaceous, and Simpson holds that the migration was not only toward the east but back again as well to the land of origin. The older migration is also indicated by the few primitive mammals (insectivores only), but mammals do not proliferate into species as do the snails. Thirty of the 50 genera, according to Anthony, and 83 of the 97 species of Antillean mammals are restricted to the islands; the outstanding feature of the fauna is its endemic nature, with relationships to South America via Central America.

"Most zoogeographers see continual land contacts in two places: an older, greater, and longer-enduring bridge from Honduras-Nicaragua across to Jamaica and Hispaniola, and a much younger, evanescent one from Yucatan to Cuba and Hispaniola. The writer does not see the evidence for the latter

bridge, and thinks that the mountain islands of Cuba may have been the asylums which retained the older fauna and received waifs from the younger one. Barbour holds that the younger bridge lasted the longer, but this does not seem to be a necessary postulate, if the mountain islands were of long endurance. The island of Hispaniola was clearly the meeting ground for both sets of migrants, and the center from which they radiated west into Cuba and east into Puerto Rico, etc. To the writer these two sets of migrations are best explained as follows: It appears to him that no bridge existed from Cuba to Yucatan after Triassic time, and more especially none during the later Cenozoic, since the latter land was then widely beneath the sea, and as for Mesozoic connection, it also appears improbable for the same reason. The only bridge that seems probable, from the geological evidence, is that from Honduras-Nicaragua to Jamaica and Hispaniola. The latter island, however, has two faunas that are more or less separated by a mountain barrier, a northern assemblage with Cuban affinities and a southern one whose relations are distinctly with Jamaica. As the writer sees the physical evidence, the Antillean basin broke down from the Gulf of Mexico southwest across the Central American geanticline, first cutting off Cuba from Central America, then sending its waters east to the south of Cuba, next separating Jamaica from Cuba but not from Haiti, and eventually cutting Cuba off from Hispaniola; thus, the Honduras-Jamaica-Hispaniola bridge was the last part of the Antillean geanticline to break down."

It seems to me that this statement covers the whole situation very satisfactorily. The details concerning the time and place of "land bridges" will always be subject to perfectly reasonable differences of opinion, inasmuch as proof often is impossible and the evidence may be variously interpreted. The writer feels, however, that Doctor Schuchert has made out a very strong case for his own view.

There has been so much of what may be called "rippling" along the whole length of the broken land mass which includes Cuba on one end and the Virgin Islands on the other, that there can be little doubt but that most or all of these lands have been under water at least once or perhaps more often. The important point being that they have never all been completely under at the same time. This statement is probably true, in part at least, for the Lesser Antillean Islands as well.

It is a general thesis that large islands support a fauna of many species and small islands do not. The abundance of different types present seems in many cases to be definitely a function of the size of the island. This plays a part in explaining conditions as we see them now. The fauna of Cuba, however, today may represent the combined population of descendants of the fauna of a considerable archipelago.

I have discussed elsewhere (Proc. Boston Soc. Nat. Hist. **40**, Feb. 1935, p. 351 et seq.) the fauna of the Bahama Islands. Since this was written a correspondent on the Island of Exuma has sent to the Museum of Comparative Zoology a box of bones found in a small, undisturbed corner of a cave from which cave earth was being taken for fertilizer. This find consisted of the remains of several hundred individuals of a *Geocapromys*, besides the remains of some extraordinarily large hawks and owls, representing new extinct genera and species. These have been studied by Doctor Alexander Wetmore.[1] Each recurring find of this sort emphasizes the extraordinary changes which have taken place in the Bahamas during the last couple of centuries, or less. These giant hawks lived, beyond doubt, in a high forest and, indeed, Columbus speaks of the big trees which he found upon landing at San Salvador. Of course Columbus may have been accustomed to a landscape in Spain, arid and with little forest, even 400 years ago; hence we may perhaps take his speaking of the forests on San Salvador with a grain of salt. On the other hand I suspect that he spoke accurately. The only remnant of forest and, indeed, it can hardly be called that today, is a stand of really large, old Gumbo limbo (*Bursera simaruba*) trees which still stand, sheltered by a low ridge called the Victoria Hills. I do not believe this covers over 50 acres, perhaps not two-thirds as much, and here, and here only, are to be found the small population of *Centurus nyeanus*. I very much doubt whether there are over 40 or 50 of these birds and should this bit of woodland go the Woodpeckers would go too. This provides a vivid demonstration of what has happened in the past to the forest fauna of the Bahamas.

While these islands may have been directly connected with the Greater Antilles, the present poverty of their fauna cannot be used as an argument to support this view for it is increasingly clear that the fauna has not always been as poor in species as it is now.

It seems to me, in the final analysis, in speculating concerning the origin of the fauna of the various island groups that two major premises must be kept in mind; first, to consider all of the animals of each island and not simply to consider the evidence based on the conditions in one group alone. Then second, the solution which most easily explains any given situation is inherently the most probable one. There has been undoubtedly some dispersal by flotsam and jetsam and some dispersal by winds and some transport by migrating birds and a good many types have been carried by man, both primitive and civilized. One of

[1] Bull. M. C. Z., **52**, 12, Oct. 1937, p. 427–441, pl. 1.

my colleagues argues for hurricane dispersal, all sorts of creatures often being carried in the rolled up "boots" of royal palm leaves. These, however, would mostly, by probability, if ever really blown away, have landed in the sea and when they did — if ever — crash to land on some distant island — or one near at hand for that matter, the passengers would have to be sturdy indeed to withstand this method of landing. Nevertheless the theory is ingenious and intriguing and may occasionally have functioned — but it is not fair to discuss his ideas before he has even had a chance to publish them. They may well turn out to be more generally popular than my own. However, to conclude that all of the animals of an island, such as any one of the Greater Antilles, have been derived by any or all of these causes is to support an explanation which is to my way of thinking infinitely less probable than to postulate extensive changes in land form in a region where so much tectionic movement is evident on every hand. That the separation of the Greater Antilles took place a long time ago is certain for Cadea was not derived from Amphisbaena nor Cricocaura differentiated from its Xantusiid forebears except in a very long time.

Professor Daly's ("The Changing World of the Ice Age," Yale Univ. Press, New Haven, 1934, pp. I–IXX and 1–271) ingenious and convincing theorem that vast bodies of water have been removed from oceanic circulation and tied up in the form of polar ice during the various periods of glaciation, thus reducing the general level of the surfaces of the oceans, would throw most of the Bahaman archipelago into a few, vast islands and even if the amount of water so tied up was only as much as Daly postulates and far less than that presumed by Shepard (Zeit. für Geomorph., **9**, 1935, pp. 99–105), great changes in topography would be brought about, and there is no reason to suppose that in a region where upthrust and downthrust block faulting seems to be prevalent that many channels between the islands may have been much shallower than they are now or even non-existent but a short time ago.

Four hundred and seventy-nine named forms are listed in this paper. In my West Indian Zoogeography of 1914 I listed two hundred and eighty-one forms from the area covered by this paper, in which the Swan Island forms are not listed, as they were in 1914.

For much pertinent comment and useful information I have first and foremost heartily to thank Major Chapman Grant. My colleagues Arthur Loveridge and Benjamin Shreve have also frequently and generously discussed problems and given me much useful advice. I have also had generous help from Dr. Stejneger and Dr. Dunn.

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Family HYLIDAE

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Cuba; also, probably accidentally, the Cayman Islands, Key West, Florida, and Northern Bahamas.

A common species.

Hyla septentrionalis dominicensis (Tschudi)

Hispaniola.

Common.

Hyla septentrionalis brunnea (Gosse)

Jamaica.

The common vicarious representative of *H. dominicensis* and *H. septentrionalis.*

Hyla vasta (Cope)

Hispaniola.

Not uncommon in some wet mountainous ravines in San Domingo.

Hyla lichenata (Gosse)

Jamaica.

Probably of the stock of *Hyla vasta* but well differentiated. This species has been studied by Dunn who finds that it lives in hollow limbs of trees. Its head is modified to close the opening of its retreat. Cf. *Bufo empusus* and the discussion of phragmotic modifications in amphibians and reptiles. (Barbour, Reptiles and Amphibians, Boston, Houghton Mifflin & Co., 1934, p. 75 et seq.) W. M. Wheeler has described nearly similar modifications among insects where the head or abdomen is modified to close the entrance to the animal's nest.

Hyla pulchrilineata (Cope)

Hispaniola.

It may have Jamaican affinity with *Hyla wilderi* or it may be autocthonously developed from *Hyla dominicensis* as Dunn suspects.

Hyla wilderi (Dunn)

Jamaica.

Found in the "wild pines," epiphytic bromeliads.

Hyla marianae (Dunn)

Jamaica.

Apparently not common anywhere and found in the highlands only.

Hyla heilprini (Noble)

Hispaniola.

Found by Noble in 1922, among stones in the ravines of mountain torrents in Pacificador Province, San Domingo.

Hyla rubra (Daudin)

South America and St. Lucia.

Reported years ago, 1891, from St. Lucia where it was doubtless accidentally introduced. We have no recent information as to its persistence.

Family BUFONIDAE

Bufo longinasus longinasus (Stejneger)

Western Cuba.

Known from the type only, taken during the summer of 1900 on the bank of a stream in the lowlands near El Guamá, a ranch near Pinar del Rio city. This species and the two following vicarious forms are not closely related to any existing toad. Many characters, however, suggest an affinity with *Bufo quercicus*. It is possible that all may have descended from some common ancestral type which occurred in what is now Central America. All of these species are singularly elusive and their erratic appearance is more like the habits of the spadefoot-toads than like the true Bufos.

Bufo longinasus dunni (Barbour)

Central Cuba.

Found abundantly after heavy rains in the mountains between Trinidad and Cienfuegos.

Bufo longinasus ramsdeni (Barbour)

Eastern Cuba.

Found by C. T. Ramsden only. Taken after heavy rains in isolated localities in the mountains about the Guantanamo basin.

Bufo peltacephalus (Tschudi)

Cuba.

Generally distributed but nowhere abundant. Not improbably a surviving representative of the same stock from which *Bufo punctatus* Baird & Girard is descended.

Bufo empusus (Cope)

Cuba.

This is the Cuban representative of the *Bufo lemur* series. It occurs in widely scattered colonies of burrows. I have described its mode of occurrence at some length elsewhere. (Mem. Mus. Comp. Zool. **44**, 1914, p. 242).

Bufo gutturosus Latrielle

Hispaniola.

A much more common species than its Puerto Rican ally.

Bufo lemur lemur (Cope)

Puerto Rico.

For forty years after its description but six of these toads were found. Modern collectors have recently secured a larger number. The four toads of this series may be allied to *Bufo canaliferus* Cope of the mainland of Central America.

Bufo lemur turpis (Barbour)

Virgin Gorda.

A very rare form. No other toad has ever been found in the Virgin Islands. It is very closely allied to *Bufo lemur* of Puerto Rico.

Bufo marinis (Linné)

Jamaica, Puerto Rico, Bermuda, Barbados, St. Lucia, St. Kitts, Martinique, Nevis and Montserrat, introduced. Native of South and lower Central America.

A favorite species for haphazard introduction.

Family LEPTODACTYLIDAE

Eleutherodactylus auriculatus auriculatus (Cope)

Cuba.

This form is characteristic of Eastern Oriente.

Eleutherodactylus auriculatus sonans (Dunn)

Cuba.

An arboreal form of Central Cuba allied to the preceding.

Eleutherodactylus auriculatus auriculatoides (Noble)

Hispaniola.

Found by Noble in bromeliads along the Constanza-Jarabacoa trail, Paso Bajito, San Domingo.

Eleutherodactylus auriculatus portoricensis Schmidt

Puerto Rico, St. John, and Tortola.

An abundant form.

Eleutherodactylus cooki Grant

Puerto Rico.

A well-defined species living in the boulder filled stream beds of the Pandura Mountains in S. E. Puerto Rico.

Eleutherodactylus audanti Cochran

Haiti.

Known only from the high La Selle massif.

Eleutherodactylus wetmorei Cochran

Haiti.

Known only from Fonds des Nègres, Haiti, where the types were taken from Palm Chat (Dulus) nests. Related to the preceding species.

Eleutherodactylus jugans Cochran

Haiti.

Once known as *Leptodactylus darlingtoni* Cochran from Morne La Selle, but proving to be an Eleutherodactylus, a new specific name had to be supplied. Cf. Journ. Wash. Acad. Sci., **27**, no. 7, July 15, 1937. p. 312. My colleague Mr. Benj. Shreve was the first to point out that Miss Cochran placed this species in the wrong genus.

Eleutherodactylus armstrongi Noble & Hassler

San Domingo.

Related to the two preceding forms and known only from Southern San Domingo.

Eleutherodactylus jamaicensis Barbour

Jamaica.

Taken at Mandeville in 1908; it has since been found in many other parts of the Island.

Eleutherodactylus lentus lentus (Cope)

St. Thomas and St. Croix.

This seems not to be a common species, according to notes kindly furnished by Major Chapman Grant.

Eleutherodactylus lentus weinlandi (Barbour)

Hispaniola.

A lowland species widely distributed in the eastern areas.

Eleutherodactylus lentus richmondi (Stejneger)

Puerto Rico.

A virgin forest form allied to *E. weinlandi* of Hispaniola and *E. lentus* of St. Thomas.

Eleutherodactylus lentus schmidti (Noble)

Hispaniola.

Another of Noble's interesting discoveries at Paso Bajito. He said it is allied to *E. weinlandi* of the Dominican Republic and to *E. richmondi* of Puerto Rico and so on to *E. lentus* of the Virgin Islands.

Eleutherodactylus glandulifer Cochran

Haiti.

A form recently found by Dr. Darlington on the northeastern foothills of the Massif de la Hotte between 1,000 and 4,000 ft. Not nearly related to any other Antillean species.

Eleutherodactylus glanduliferoides Shreve

Haiti.

Said to be related to the preceding, and so far known only from the higher portions of the La Selle range, 5000–7000 ft.

Eleutherodactylus brevirostris Shreve

Haiti.

Related to the preceding and probably confined to the La Hotte Massif.

Eleutherodactylus inoptatus (Barbour)

Hispaniola.

An enormous species which barks when handled and which is found in both Haiti and San Domingo. By far the finest species of the genus. It resembles superficially and probably fortuitously *E. insignitus* from the Sta. Marta Mts. of Colombia.

Eleutherodactylus darlingtoni Cochran

Haiti.

Another very distinct form from the high La Selle Range, 5,000–7000 ft.

Eleutherodactylus ruthae Noble

Hispaniola.

Noble described this species from Samana, R. D., and he considers it allied to *E. inoptatus*.

Eleutherodactylus urichii (Boettger)

St. Vincent, Grenada, Trinidad.

Specimens from Grenada and St. Vincent seem to be separated by color characters and may be worthy of a name, but both forms are very variable.

Eleutherodactylus martinicensis (Tschudi)

Saba, Montserrat, St. Kitts, St. Eustatius, St. Martins, Martinique, Guadeloupe, Grenada, St. Vincent, Jamaica (introduced near Kingston about 1890).

This little frog is so easily carried about that its true original distribution will never be known.

Eleutherodactylus brittoni Schmidt

Puerto Rico.

Another from the forest on El Yunque.

Eleutherodactylus abbotti Cochran

Hispaniola.

Said to be a very common species throughout San Domingo.

Eleutherodactylus bakeri Cochran

Haiti.

Another of Dr. Darlington's recent finds from Mt. La Hotte, 5,000-7,800 ft.

Eleutherodactylus montanus Schmidt

Hispaniola.

A species from the Cibao Mountains.

Eleutherodactylus semipalmatus Shreve

Haiti.

From the Massif de la Hotte.

Eleutherodactylus pictissimus Cochran

Haiti.

Another new form from Mt. La Hotte, 3000 ft.

Eleutherodactylus femur-laevis Cochran

Haiti.

Another form just found and known only from the type locality, Morne La Hotte, 4000 feet.

Eleutherodactylus minutus Noble

Hispaniola.

On ferns in palm thickets on trail near Paso Bajito, San Domingo; fide Noble.

Eleutherodactylus rufifemoralis Noble & Hassler

San Domingo.

Found in the hills near Barahona.

Eleutherodactylus orcutti Dunn

Jamaica.

A local form from Arntully in St. Thomas Parish.

Eleutherodactylus cunctator Dunn

Jamaica.

Known only from Arntully in St. Thomas Parish.

Eleutherodactylus nubicola Dunn

Jamaica.

Found high in the Blue Mountains, 3,000–5,100 feet.

Eleutherodactylus luteolus (Gosse)

Jamaica.

Common and widely distributed; from Port Antonio to Montego Bay.

Eleutherodactylus gossei Dunn

Jamaica.

Widespread at altitudes of about 1,000 feet.

Eleutherodactylus pantoni Dunn

Jamaica.

The largest Jamaican species.

Eleutherodactylus junori Dunn

Jamaica.

Known only from Spaldings, Clarendon Parish, altitude 2,900 feet.

Eleutherodactylus cundalli Dunn

Jamaica.

A woodland species, as yet but little known.

Eleutherodactylus grabhami Dunn

Jamaica.

A small species with a wide range, as to both area and altitude.

Eleutherodactylus andrewsi Lynn

Jamaica.

Just discovered in the Blue Mountains.

Eleutherodactylus alticola Lynn

Jamaica.

From the highest peak in the Island. An inquiry to Professor E. R. Dunn as to the interrelationships of these Jamaican frogs brought this prompt and much appreciated reply, "I saw Lynn's material and think the *luteolus* group splits up into:

> a large form, *pantoni*
> three medium sized forms, vicarious, *gossei-luteolus-nubicola*
> two small forms, *junori* and *andrewsi*. These last may turn out to be subspecies of each other but I don't see it yet. Three forms occur together at Spaldings."

Of course it would be impossible to express this situation nomenclatorially without making a subgenus or superspecies within Eleutherodactylus and it is not time for this yet.

Eleutherodactylus varleyi Dunn

Cuba.

Known from Central and Eastern Cuba and said by Dunn to be allied to *E. minutus* and *E. abbotti* of San Domingo.

Eleutherodactylus parvus Barbour & Shreve

Eastern Cuba.

One of Dr. Darlington's finds from Mt. Turquino.

Eleutherodactylus atkinsi atkinsi Dunn

Cuba.

A handsome species found throughout the Island.

Eleutherodactylus atkinsi orientalis Barbour & Shreve

Eastern Cuba.

An inhabitant of the highlands only so far as known.

Eleutherodactylus varians (Gundlach & Peters)

Cuba.

Known definitely only from Soledad, near Cienfuegos.

Eleutherodactylus eileenae Dunn

Cuba.

The "Kolin" of western and central Cuba.

Eleutherodactylus dimidiatus (Cope)

Cuba.

A widespread species.

Eleutherodactylus emiliae Dunn

Cuba.

Known only from the Mina Carlota, in the mountains not far from Cumanayagua, Sta. Clara Province.

Eleutherodactylus albipes Barbour & Shreve

Eastern Cuba.

Another of Dr. Darlington's prizes from Mt. Turquino. Related to the preceding.

Eleutherodactylus intermedius Barbour & Shreve

Eastern Cuba.

Another denizen of Turquino, perhaps akin to both the preceding forms.

Eleutherodactylus pinarensis Dunn

Cuba and Isle of Pines.

Known in Cuba from the Province of Pinar del Rio only.

Eleutherodactylus greyi Dunn

Cuba.

The largest Cuban species, so far known only from the mountains between Cienfuegos and Trinidad.

Eleutherodactylus brevipalmatus Schmidt

Cuba.

A form from the mountains of the province of Oriente.

Eleutherodactylus sierrae-maestrae Schmidt

Cuba.

Another mountain species from eastern Cuba. May not be distinct from the preceding.

Eleutherodactylus turquinensis Barbour & Shreve

Eastern Cuba.

An inhabitant of Turquino Peak and an ally of the foregoing.

Eleutherodactylus ricordii (Duméril & Bibron)

Cuba and Bahama Islands; S. Florida.

Found in all parts of Cuba and on New Providence, Abaco and Andros Island. It is extending its range in Florida, as I reported some years ago. It has now reached Gainesville. (Proc. Biol. Soc. Wash., **23**, 1910, p. 100).

Eleutherodactylus cuneatus (Cope)

Cuba and Isle of Pines.

Common in western and central Cuba.

Eleutherodactylus gundlachii Schmidt

Cuba.

An eastern mountain form. I originally described this species but used the specific name *plicatus*, which proved to be preoccupied.

Eleutherodactylus casparii Dunn

Cuba.

Another species of the Trinidad Mountains.

Eleutherodactylus gryllus Schmidt

Puerto Rico.

A minute, highland species.

Eleutherodactylus cochranae Grant

St. John and Hassel Island.

Perhaps akin to the preceding species. Hassel Island is a small Cay near St. Thomas.

Eleutherodactylus locustus Schmidt

Puerto Rico.

Another species from El Junque forest.

Eleutherodactylus cramptoni Schmidt

Puerto Rico.

A rare species from the mountain forest of El Yunque Peak.

Eleutherodactylus antillensis (Reinhardt & Lütken)

Puerto Rico, St. Thomas, Tortola, Vieques, Culebra, St. John.

A widespread and common species.

Eleutherodactylus wrightmanae Schmidt

Puerto Rico.

A form "probably confined to the coffee belt and the wet forest above it."

Eleutherodactylus unicolor Stejneger

Puerto Rico.

From El Junque.

Eleutherodactylus monensis (Meerwarth)

Mona Island.

Eleutherodactylus flavescens Noble

Hispaniola.

From bushes along streams near La Bracita, found by Noble in 1922.

Eleutherodactylus karlschmidti Grant

Puerto Rico.

Known from the mountain cataracts of Puerto Rico and said not to be very closely related to any other Antillean member of the genus.

Leptodactylus fallax Muller

Dominica, St. Kitts, Guadeloupe, St. Lucia.

The giant "crapaud" has been recently separated specifically from the mainland *L. pentadactylus.* Now to be found on Dominica only, where it is called the "mountain chicken." Elsewhere it has been exterminated by the mongoose. It may have occurred upon islands other than those recorded above. Introduced in Puerto Rico in 1929 and 1932. The imported population which was taken while calling at night in Dominica may be males only, according to Major Chapman Grant.

Leptodactylus dominicensis Cochran

Hispaniola.

The Dominican representative of *L. albilabris* of Puerto Rico and the Virgin Islands.

Leptodactylus albilabris (Günther)

St. Thomas, St. Croix, St. John, Tortola, Anegada, Just van Dyke, Puerto Rico, Vieques, Culebra.

This common form no doubt occurs on other islets in this general area.

Leptodactylus validus Garman

St. Vincent, Grenada, Venezuela.

There is a great question whether this form is distinct or identical with *L. caliginosus* from Brazil and just what the relationship may be with *L. labialis* or *L. melanonotus* from Central America.

Family BRACHYCEPHALIDAE

Sminthillus limbatus limbatus (Cope)

Cuba.

Locally abundant. It is perhaps more conservative to consider these little frogs to constitute a separate Cuban genus.

Sminthillus limbatus orientalis Barbour & Shreve

Eastern Cuba.

A well defined color form, so far as known confined to El Yunque de Baracoa.

Class REPTILIA

Order SQUAMATA

Suborder SAURIA

Family GEKKONIDAE

GYMNODACTYLUS FASCIATUS Duméril & Bibron

Martinique.

I know nothing of this species and have often wondered what it is. The type in Paris was said to be from the Plée Collection and taken at Martinique. The Plée Collections have caused endless confusion by having so often erroneous data as to locality. I suspect that I would have done better to have omitted this species altogether.

GONATODES ALBOGULARIS (Duméril & Bibron)

Martinique, Curaçao.

This, another Plée type from "Martinique," may have come from almost anywhere in the Caribbean basin. Many of the members of this genus are in confusion and await a reviser.

GONATODES NOTATUS (Reinhardt & Lütken)

Hispaniola.

Apparently a valid species which may be confined to Haiti. It seems to be rare.

GONATODES FUSCUS (Hallowell)

Cuba and Central America.

This house lizard is known from the seaports of Santiago, Havana and Mariel, which are in constant schooner communication with Havana. I suspect the species was long since accidentally introduced into Cuba.

PHYLLODACTYLUS SPATULATUS Cope

Barbados.

Collected years ago, about 1861, in fact, by Dr. Theodore Gill. I have no recent information as to its status.

Phyllodactylus martini Van Lidth de Jeude

Venezuela, Curaçao, Bonaire, Puerto Rico and Caja de Muertos.

Major Grant found three specimens from these two last mentioned islands. Of course, above all other lizards, geckos are distributed without rhyme or reason. This form was first described from Caracas. Grant recorded the species as *P. pulcher*.

Hemidactylus mabouia (Moreau de Jonnés)

Cuba, Jamaica, Hispaniola, Vieques, St. Thomas, St. Croix, St. John, Just van Dyke, Tortola, Dominica, St. Lucia, St. Vincent, Barbados, Martinique, Grenada and the Grenadines; Northern South America, Trinidad; West Africa from Liberia to Angola, East Africa from Italian Somaliland to the Zambesi.

This lizard, one frequenting the street lamp areas of towns and cities, is, I believe, accidentally introduced. It is rare in the Greater Antilles, and in Cuba very local.

Hemidactylus brookii Gray

Asia; tropical Africa; Cuba, Hispaniola, Puerto Rico.

I believe this is another accidental introduction.

Hemidactylus turcicus (Linné)

The Eastern Mediterranean Islands.

Introduced to Key West and Miami, Florida, Cuba, and Yucatan.

Thecadactylus rapicaudus (Houttuyn)

Saba south to Grenada, tropical South and Central America.

Nocturnal or crepuscular. Found under bark, behind shutters and in old buildings, also in the forest in crevices of rocks and sometimes under decaying vegetable trash. It is known from almost every single island, all indeed which have been in any sense completely explored.

Aristelliger praesignis (Hallowell)

Jamaica, Grand Cayman and Cayman Brac.

An abundant, if not actually common, species.

Aristelliger lar Cope

Hispaniola.

Apparently rather widely distributed. It has recently been collected in larger numbers than the earlier investigators uncovered.

Aristelliger expectatus Cochran

Haiti and La Gonave.

A small species related to the one on Navassa. Known from Southern Haiti and La Gonave Island.

Aristelliger cochranae Grant

Navassa Island.

Allied to Miss Cochran's species from Haiti.

Aristelliger barbouri (Noble & Klingel)

Inagua.

Known from Southwest Point, Great Inagua, only.

Tarentola cubana Gundlach & Peters

Cuba and Bahamas.

Shy and retiring in rocky crevices, this species is rarely seen. I suspect it to be widespread in the Bahamas, though I have seen it from Andros and Exuma Islands only. In Cuba it is more common in the northeastern region than elsewhere.

Sphaerodactylus roosevelti Grant

Puerto Rico, Vieques.

Said by the describer to be the only species in the genus with keeled scales on the chest.

The relationships within this genus are as yet not clearly understood for the present. I think it is better to let most of them stand as binominals.

Sphaerodactylus decoratus Garman

Bahama Islands.

Common on Andros, rare on New Providence. The type came from Rum Cay.

Sphaerodactylus stejnegeri Cochran

Haiti.

A species known from several different parts of the Republic of Haiti.

Sphaerodactylus gibbus Barbour

Bahama Islands and Eastern Cuba.

Known principally from the Exuma Cays.

Sphaerodactylus torrei Barbour

Cuba.

Known from the Province of Oriente only. It is not rare.

Sphaerodactylus cinereus Wagler

Cuba, Navassa, Hispaniola and extreme south Florida.

A common form in houses and in woodlands. It passes through a number of color phases during growth and the young and half-grown were once thought to be distinct species and bore specific names, elegans and intermedius.

Sphaerodactylus mariguanae Cochran

Mariguana Island.

This form is said by the describer to be much like the following.

Sphaerodactylus oxyrrhinus Gosse

Jamaica.

A rare form but one widespread through the Island.

Sphaerodactylus armstrongi Noble & Hassler

San Domingo.

Known only from the Province of Barahona.

Sphaerodactylus difficilis Barbour

Hispaniola.

Common and widely distributed.

Sphaerodactylus altavelensis Noble & Hassler

Alta Vela Island.

Represents the stock of the preceding species on Alta Vela.

Sphaerodactylus notatus Baird

Florida Keys and extreme southern Florida, Cuba, Isle of Pines and Bahama Islands.

A very common house lizard. No doubt often carried about and rapidly extending its range.

Sphaerodactylus macrolepis Günther

Congo Key, Little St. James, St. Croix, Water Island, St. Thomas, St. John, Tortola, Virgin Gorda, Anegada.

Widespread and common.

Sphaerodactylus danforthi Grant

Culebra and Vieques.

Representing the preceding species on this Island.

Sphaerodactylus grandisquamis Stejneger

Puerto Rico.

Another representative of this same stock which Grant believes valid and confined to Puerto Rico.

Sphaerodactylus monensis (Meerwarth)

Mona.

Grant believes this species should be held as distinct.

Sphaerodactylus townsendi Grant

Northeastern Puerto Rico, Vieques and Caja de Muertos.

A form close to *S. monensis.*

Sphaerodactylus richardsoni Gray

Jamaica.

A fine big form but one which is distinctly rare.

Sphaerodactylus becki Schmidt

Navassa.

I am not sure, judging from the second known specimen recently collected, that this species is really separable from *S. scaber* of Cuba.

Sphaerodactylus inaguae Noble & Klingel

Inagua, and Watlings Island.

Common in and about Matthewtown.

Sphaerodactylus gilvitorques Cope

Jamaica.

I know nothing of this species. I have never found it; nor has any of our various collectors in Jamaica. The types were taken "during the forties" by Dr. Pennock of Philadelphia.

Sphaerodactylus nigropunctatus Gray

Cuba.

A rare species from Eastern Cuba.

Sphaerodactylus caicosensis Cochran

The Caicos Islands.

Recently described from South Caicos Island. Apparently most like the following.

Sphaerodactylus corticolus Garman

Bahamas Islands.

Known from Watlings Island and Rum Cay. No doubt it occurs in many other islands beside these.

Sphaerodactylus festus Barbour

Martinique.

Known from but few specimens but no doubt common.

Sphaerodactylus goniorhynchus Cope

Jamaica.

A very common woodland species.

Sphaerodactylus argus argus (Gosse)

Jamaica.

An excessively common species both in houses and out of doors. Possibly introduced casually into Cuba and the Bahamas.

Sphaerodactylus argus bartschi (Cochran)

Little Cayman.

A recently described form allied to *S. argus* of Jamaica.

Sphaerodactylus argus argivus (Garman)

Cayman Brac.

A derivative of *S. argus* of Jamaica. A fairly well defined species. It is apparently known from the type series only.

Sphaerodactylus anthracinus Cope

Bahama Islands.

Only known from Andros Island.

Sphaerodactylus copei Steindachner

Hispaniola.

A fine, big, rough-scaled species which is rare and apparently confined to Haiti.

Sphaerodactylus scaber Barbour & Ramsden

Cuba.

Found in the hills of central Cuba.

Sphaerodactylus samanaensis Cochran

San Domingo.

Known only from the vicinity of Samana Bay.

Sphaerodactylus fantasticus Duméril & Bibron

Guadeloupe.

Very abundant.

Sphaerodactylus pictus Garman

St. Kitts, Nevis.

Probably abundant, and possibly a synonym of the following.

Sphaerodactylus sputator (Sparrman)

St. Eustatius.

The types in Stockholm were long the only specimens known but recently the Museum in Cambridge has received many freshly captured specimens.

No Sphaerodactyli are as yet known from St. Martin, Saba, Redonda and other small islands in this neighborhood.

Sphaerodactylus elegantulus Barbour

Antigua and St. Lucia, perhaps introduced.

An ally of *pictus* and *sputator*. Brilliantly banded when young and less ornamented in adult life—like so many of the curious little beasts.

Sphaerodactylus microlepis Reinhardt & Lütken

St. Lucia.

I know little of the status of this and several others of the Lesser Antillean forms.

Sphaerodactylus klauberi Grant

Puerto Rico.

One of the small series of species with keeled belly scales.

Sphaerodactylus gaigeae Grant

Mountains between Maunabo and Yabacoa, Puerto Rico.

A small dark colored species known only from the collection of Major Chapman Grant whose unbounded industry has made him the peerless authority on the herpetology of the Puerto Rican area.

Sphaerodactylus vincenti Boulenger

St. Vincent.

No information available as to present status.

Sphaerodactylus nicholsi Grant

Puerto Rico.

Said to be somewhat similar to the species from St. Vincent. A chance resemblance no doubt.

Sphaerodactylus monilifer Barbour

Dominica.

Probably abundant but I have no real information about this species.

Family IGUANIDAE

Iguana iguana iguana (Linné)

St. Thomas, Water Island, Hassel Island, Tortola, Peter Island, Guana Island, St. John, Saba, Grenada, Tobago, Trinidad, tropical lowlands of South America from western Panama to Brazil.

Dr. Dunn has recently examined all available material of the genus Iguana and this arrangement is based on his conclusions. (Copeia, 1934, p. 1.)

Iguana iguana rhinolopha (Wiegmann)

?St. Kitts, ?St. Lucia, Swan Island, lowlands of tropical Central America from Costa Rica northward in rain forest areas to the states of Guerrero and Vera Cruz, Mexico.

The Swan Island specimens are unstable and many possess and many lack the nasal spines. The Antillean specimens are probably based on specimens incorrectly labelled as to locality. If there really ever were iguanas on these islands, the mongoose has exterminated them. There is what may be an iguana egg from St. Lucia in the Mus. Comp. Zool. It is so labelled, and it was taken many years ago.

Iguana delicatissima Laurenti

Anguilla, St. Martins, St. Bartholemew, St. Eustatius, Nevis, Guadeloupe, Les Saintes.

This species has been recorded from Swan Island, where it is not now found and from the Caymans where it is either very rare or occasionally brought in by the very widely seafaring people.

CHAMAELEOLIS CHAMAELEONIDES (Duméril & Bibron)

Cuba.

The most peculiar of all the offshoots from the Anoline stock. A rare species and beyond doubt a monotypic genus, in spite of several names applied with the idea of multiplying the forms.

XIPHOCERCUS VALENCIENNESII (Duméril & Bibron)

Jamaica.

Not uncommon in woods and fruit plantations. It may be related to Phenacosaurus of Colombia or be simply a chance offshoot from Anolis in Jamaica and Haiti and only fortuitously similar to the South American genus.

XIPHOCERCUS DARLINGTONI Cochran

Haiti.

A surprising discovery, made in 1935 by Dr. Darlington of Harvard at Roche Croix, Massif de la Hotte, 5,000 ft. Another Jamaican genus in Hispaniola.

CHAMAELINOROPS BARBOURI Schmidt

Navassa.

Not found during the careful exploration of Clench, Schevill and Rehder during January, 1930. Possibly exterminated by introduced animals.

CHAMAELINOROPS WETMOREI Cochran

Hispaniola.

The unique type is from near Miragoane, Haiti.

AUDANTIA ARMOURI Cochran

Haiti.

Recently discovered on the Morne La Selle. It resembles Plica or Leiocephalus superficially but more probably it represents the stock of the following genus. Found by Dr. Darlington also on Morne La Hotte.

DEIROPTYX VERMICULATA (Duméril & Bibron)

Cuba.

Bank of streams of Pinar del Rio Province, taking refuge in the water and hiding among submerged rocks and stones when pursued.

Deiroptyx bartschi Cochran

Cuba.

Long unrecognized but not rare in western Cuba.

Anolis equestris equestris Merrem

Havana Province to Western Oriente, Cuba.

The finest and largest form in the genus. Rather uncommon everywhere but wide ranging. Less common than its allies, *A. garmani* of Jamaica and *A. ricordii* of Hispaniola, and about equally abundant with *A. cuvieri* of Puerto Rico. These are the "Giant Anoles" of the Antilles and they may be related to the *A. insignis* group of Central America.

Anolis equestris luteosignifer (Noble & Hassler)

Western Cuba.

Replaces the preceding form in the Pinar del Rio area east to about San Antonio de los Baños in Havana province.

Anolis equestris noblei Barbour & Shreve

Eastern Cuba.

Replaces the typical forms from Nipe Bay to the Mantanamo basin.

Anolis equestris hassleri Barbour & Shreve

Island of Pines.

The representative form on this island.

Anolis cuvieri Merrem

Puerto Rico and Vieques.

A rather uncommon member of the series of "Giant Anoles." Recorded from Tortola but Major Grant doubts its occurrence there.

Anolis roosevelti Grant

Culebra.

Apparently a very fine and distinct form.

Anolis ricordii Duméril & Bibron

Hispaniola.

One of the "Giant" series. Found throughout the whole Island and next to *A. garmani* of Jamaica the most abundant of the tribe.

Anolis garmani Stejneger

Jamaica.

The beautiful great green or barred "Venus Lizard" of Jamaica. A common woodland form, by far the most abundant of the group of the "Giant Anoles."

Anolis porcatus porcatus (Gray)

Cuba and Isle of Pines.

A very abundant species. The "Chamaeleon" now sold iniquitously by thousands at "the circus." It has replaced its ally, our southern "Chamaeleon," *A. carolinensis* (Voight) in this hateful traffic.

Anolis porcatus maynardi (Garman)

Grand Cayman.

This extraordinary lizard, the most extreme member of the long-headed series, is by no means common.

Anolis porcatus brunneus (Cope)

Crooked Island, and the neighboring islands, and probably also Watlings Island.

A fine series of topotypes defines this beautiful species, long confused for lack of topotypes.

Anolis porcatus smaragdinus (Barbour and Shreve)

Bahamas.

The species which has been called *A. porcatus* and *A. brunneus* by recent authors but which is a perfectly distinct species inhabiting the islands of the Great Central Bahama Bank, Andros, New Providence, Eleuthera, Long, etc. The common green anole of the Central Bahamas.

Anolis porcatus fairchildi (Barbour and Shreve)

Cay Sal Group, Bahamas.

A green anole of the porcatus-principalis-smaragdinus-brunneus series, perfectly distinct and confined to this isolated group of islets.

Anolis porcatus longiceps Schmidt

Navassa.

Apparently the only species at present to be found in any number on this Island.

Anolis bohorucoensis Noble & Hassler

San Domingo.

A fine species apparently confined to the Sierra de Bohoruco, southern San Domingo.

Anolis chloro-cyanus Duméril & Bibron

Hispaniola.

A widespread and not uncommon form.

Anolis allogus allogus (Barbour & Ramsden)

Cuba.

This fine form has a wide distribution in the mountains of eastern Cuba.

Anolis allogus mestrei Barbour & Ramsden

Cuba.

A rather rare species of the higher woods in the limestone hills of western Cuba.

Anolis allogus ahli Barbour

Cuba.

Confined to the mountains between Trinidad and Cienfuegos. Not uncommon in high damp woods. *Anolis abatus* Ahl probably belongs here.

Anolis bimaculatus Sparrman

St. Eustatius, St. Kitts and Nevis.

Abundant. A strictly arboreal species.

ANOLIS EVERMANNI Stejneger

Puerto Rico.

A highland species which may be related to *A. leucophaeus* of Inagua. An abundant form.

ANOLIS KRUGI ACUTUS (Hallowell)

St. Croix.

This is still an abundant form. I have just received a fine series. Major Grant agrees that *A. newtoni* belongs here as a synonym.

ANOLIS KRUGI KRUGI (Peters)

Puerto Rico.

A small species belonging to what I call the rupicolous as against the arboreal Lesser Antillean series.

ANOLIS KRUGI WATTSI (Boulenger)

St. Kitts, Nevis, St. Eustatius and Antigua.

A pretty little species found on the outcrops of igneous rock and, insofar as my experience goes, not in trees. It is one of the *A. acutus* allies.

ANOLIS KRUGI FORRESTI (Barbour)

Barbuda.

Mr. Parker has recently let me see more material from this island. The form is close to the preceding but, I think, quite valid.

ANOLIS KRUGI GINGIVINUS Cope

St. Martins, St. Barts, Anguilla and St. Eustatius.

Common. A member of the series of small sized Lesser Antillean species.

ANOLIS GUNDLACHI Peters

Puerto Rico.

Apparently an abundant species.

ANOLIS SABANUS Garman

Saba.

A most remarkably differentiated form, a rock lizard, pure and simple. The males with really leopard-like spotting. It is so well defined that I think it had best stand alone.

ANOLIS LEACHII LEACHII Duméril & Bibron

Guadeloupe.

This form having the oldest name heads the series comprising most of the large arboreal Lesser Antillean Auoles.

ANOLIS LEACHII ANTIQUAE (Barbour)

Antigua.

A beautiful and common arboreal species.

ANOLIS LEACHII LIVIDUS (Garman)

Montserrat.

All the lizards are said still to be common on this Island.

ANOLIS LEACHII BARBUDENSIS (Barbour)

Barbuda.

Mr. Parker of the British Museum has just allowed me to examine some specimens of this form hitherto known from the type only. It now appears that this race is very close if not really indistinguishable from the form on Antigua. More material from both islands is needed to settle the question.

ANOLIS LEACHII TERRAE-ALTAE (Barbour)

Les Saintes; near Guadeloupe.

A fine big species which Noble found abundant in 1914.

ANOLIS LEACHII ALLIACEUS (Cope)

Dominica.

I was surprised in 1929 to find that this species seemed much less conspicuous and common than its allies on other islands nearby. So much for what may have been a most erroneous conclusion drawn from the visit of a few days only. It is, however, by no means rare.

Anolis leachii nubilus (Garman)

Redonda.

A beautiful great lizard; one of the finest in the genus. It is known only from the original series.

Anolis asper Garman

Marie Galante.

A bizarre and gorgeous species common on the old mango trees—about the only trees still standing over a large part of this hurricane-stricken isle. This form is so distinct and so highly specialized that it must surely stand as a full species although no doubt it belongs in this category as far as ancestry is concerned.

Anolis richardii Duméril & Bibron

Grenada and Tobago.

A splendid great lizard; a strict tree-dweller.

Anolis cristatellus cristatellus (Duméril & Bibron)

Puerto Rico, Vieques, St. Thomas, St. John, St. James, Anegada, Fallen Jerusalem, Tortola, Virgin Gorda, Guana Island, Peter Island, Water Island and Mosquito Island.

A common and handsome species. It has been suggested that a separate genus be established for the fin-tailed species, but as a matter of fact this character appears in various phyla and it may not always be a token of relationship.

Anolis cristatellus wileyi Grant

Culebra.

A form differing in color, and apparently constantly, from the typical race and found on Culebra and the surrounding Cays.

Anolis cristatellus cooki Grant

Southwestern Puerto Rico.

A well defined race confined to the desert area about La Brea Point.

Anolis cristatellus monensis (Stejneger)

Mona.

Apparently a common species.

Anolis alutaceus alutaceus (Cope)

Cuba and Isle of Pines.

Known from all parts of the Island but nowhere abundant. A species of the low scrublands.

Anolis alutaceus clivicolus Barbour and Shreve

Eastern Cuba.

A mountain form which in several areas seems to intergrade with the preceding race.

Anolis spectrum Peters

Cuba.

A not uncommon lizard in woodlands during the rainy season. It disappears completely during the dry portion of the year. It may tie in with one of the *A. semilineatus*, *A. olssoni*, *A. hendersoni* series of Haiti.

Anolis cyanopleurus Cope

Cuba.

A marvelously beautiful species which Dr. Ramsden has rediscovered in the old type locality, the mountains about Guantanamo. I suspect from the habit that it must be terrestrial. It is said to be local and uncommon.

Anolis semilineatus Cope

Hispaniola.

An abundant cursorial grass-living form. It is not improbable that trinominal designation may be indicated if the ranges of this and the two following forms can be shown *not* to overlap.

Anolis olssoni Schmidt

Hispaniola.

Apparently a not uncommon member of the group of slender terrestrial species long confused with *A. semilineatus* and allied to *A. spectrum* of Cuba.

Anolis hendersoni Cochran

Hispaniola.

A small terrestrial species mostly, if not wholly, from the western portion of the Island.

Anolis poncensis Stejneger

Puerto Rico.

A rare local species. One which is terrestrial and almost Norops-like in habit.

Anolis pulchellus Duméril & Bibron

Puerto Rico, Vieques, Culebra, St. John, St. James, Virgin Gorda, Tortola, Peter Island, Guana Island, Anegada, St. Thomas, St. Croix, Just van Dyke.

A common ground-living species. Doubtfully recorded from Haiti.

Anolis latirostris Schmidt

Navassa.

Known from the unique type only. Now apparently extinct. Possibly a terrestrial form, hence a prey to the cats left when the lighthouse was made automatic and the keepers were moved away. Most lizards and all snakes have probably gone from Navassa except Anolis longiceps which is strictly arboreal.

Anolis stratulus Cope

Puerto Rico, Vieques, Culebra, St. John, St. Thomas, Tortola, Peter Island, Guana Island, Fallen Jerusalem and Just van Dyke.

A common lowland species.

Anolis coelestinus Cope

Hispaniola.

I have seen this form from Haiti only.

Anolis distichus distichus (Cope)

Bahama Islands.

Common on the ceiba trees on New Providence Island. It occurs on Eleuthera, Long Island, Rum Cay and Watlings Island as well. Mr. Shreve is of the opinion that the Rum Cay form may be distinct but I only got a single specimen there in 1934.

Anolis distichus distichoides (Rosén)

Andros Island.

A poorly defined form replacing *A. distichus.* It is very abundant.

Anolus distichus dominicensis (Reinhardt & Lütken)

Hispaniola.

This species is not uncommon in Haiti but the stock seems to be rare on La Gonave. I secured a small series in 1929 — but in a very dry time.

Anolis distichus caudalis (Cochran) .

La Gonave Island.

Representative of a plastic stock on La Gonave.

Anolis distichus wetmorei (Cochran)

Beata Island.

Confined to this island where it seems to be very rare. Beata is now swarming with feral dogs, cats and goats — fauna and flora are suffering as one might expect. Ground lizards with whole tails are now rare — as soon the lizards themselves will be also.

Anolis distichus altavelensis (Noble & Hassler)

Alta Vela Island.

A rather poorly defined form.

Anolis distichus juliae Cochran

Isle Vache.

A recently discovered form.

Anolis sagrei sagrei (Duméril & Bibron)

Cuba and Isle of Pines; probably introduced into Jamaica and Belize.

The commonest Anolis and, as its range is wide in Cuba, perhaps this form has the largest species population in the genus. The commonest fence, house-wall and brush lizard in Cuba, by far.

Anolis sagrei ordinatus (Cope)

Bahamas.

Known from Turks Island to New Providence. Common everywhere.

ANOLIS MONTICOLA Shreve

Haiti.

Found by Dr. Darlington in the eastern foothills of Morne La Hotte. Said to be related to *A. sagrei* and perhaps should be trinominally designated.

ANOLIS LUTEOSIGNIFER Garman

Cayman Brac.

Probably as abundant as it ever was.

ANOLIS LINEATOPUS Gray

Jamaica.

The common fence lizard of the dry Liguanea Plain about Kingston. It swarms here but occurs nowhere else, so far as anyone knows at present.

ANOLIS HOMOLECHIS HOMOLECHIS (Boulenger)

Cuba and Isle of Pines.

A widespread and not uncommon species found in wooded ravines or lowland woods and heavy scrub.

ANOLIS HOMOLECHIS RUBRIBARBUS (Barbour & Ramsden)

Cuba.

Known only from a very few specimens from Puerto Cananova on the north coast of the oriental province.

ANOLIS HOMOLECHIS QUADRIOCELLIFER (Barbour & Ramsden)

Cuba.

Known only from the Cape San Antonio region of extreme western Cuba.

ANOLIS HOMOLECHIS PATRICIUS (Barbour)

Cuba.

Only known from a series taken by Dr. Ramsden at Mina Piloto, near Sagua de Tanamo, northern coast of Oriente Province.

Anolis greyi Barbour

Cuba.

Only known from a small number taken in the town of Camaguey and in the Cubitas range of hills not far away.

Anolis cybotes cybotes (Cope)

Hispaniola.

Common as are the allies of *A. sagrei* wherever they occur. This is one of a series of dominant and successful races.

Anolis cybotes doris (Barbour)

La Gonave.

I have now seen a good many specimens of this lizard. We may follow Miss Cochran in giving it subspecific rank.

Anolis cybotes longitibialis (Noble)

Beata Island.

I have found this lizard rare on several visits to Beata.

Anolis angusticeps angusticeps Hallowell

Cuba and Isle of Pines.

I consider this a really rare species in both western and eastern Cuba. It is more abundant in the Isle of Pines.

Anolis angusticeps oligaspis Cope

Bahamas.

Found upon New Providence (Hog Id. type), Andros I., (U.S.N.M.) and Long Island (Barbour). It is the rare representative of *A. angusticeps* of Cuba. It may occur also upon other islands. Much intensive herpetological work remains to be done in the central and southern Bahama Islands.

Anolis isolepis Cope

Cuba.

An excessively rare species. It occurs in the mountains of Oriente Province.

Anolis lucius Duméril & Bibron

Cuba.

The abundant lizard of the limestone cliffs and open caves of central Cuba from Matanzas and Santa Clara Provinces, especially.

Anolis argenteolus Cope

Cuba.

Found in the Province of Oriente. Far from rare, it occurs on rocks, cliffs, and often also on building walls and fences. I have taken it on the trunks of the great *Ficus nitida* (Sp. Laurél de la India) trees which used to stand in the Plaza at Santiago.

Anolis argillaceus Cope

Cuba.

I have never seen this species in life. Dr. Ramsden says it is not uncommon in the old coffee plantations high in the mountains about Guantanamo.

Anolis bremeri Barbour

Cuba.

A fine, striking species, known only from the type which I took years ago at Herradura in Pinar del Rio Province. One of the most distinct species in Cuba. Its great maroon-brown gular fan is wholly unlike that of any other Anole.

Anolis loysiana Cocteau

Cuba.

A rare and bizarre little lizard. It is found sparingly all over Cuba on trees having a light colored bark. It is extraordinarily like rough bark in appearance. Some believe that the genus Acantholis proposed to contain this species is really valid. It becomes more common during the summer rains than it is in the dry season, our winter.

Anolis leucophaeus leucophaeus (Garman)

Inagua.

A common species.

Anolis leucophaeus albipalpebralis (Barbour)

Turks and Caicos Islands.

This species seems plastic like *A. dominicensis.*

Anolis leucophaeus mariguanae Cochran

Mariguana Island.

Another good representative race.

Anolis leucophaeus sularum Barbour and Shreve

Atwood's Cays, Bahamas.

A race, about as good as the others, which Mr. Greenway recently found on West Booby Cay in the Atwood's Cay group.

Anolis roquet roquet (Lacépède)

Martinique.

This heads the lot of the smaller Lesser Antillean races. They are less well defined in general than the races of *A. leachii.* In some cases they can only be told apart while living, their colors then being quite diagnostic. They usually frequent the beach grape and poison wood trees about the shores of the Island. The larger races inhabit the inland forests. To this stock belongs also *A. aeneus* Gray of Trinidad and *Anolis bonairiensis* Ruthven.

Anolis roquet marmoratus (Duméril & Bibron)

Desirade.

I know nothing of this form. Garman found it abundant in 1882.

Anolis roquet luciae Garman

St. Lucia.

Apparently, like so many Antillean species, whether from one reason or another much less common than formerly.

Anolis roquet vincentii Garman

St. Vincent.

Like most of the reptiles of this Island, this species is now rare.

Anolis roquet gentilis Garman

Grenada and the Grenadines.

A rather small, inconspicuous lizard which is still abundant.

Anolis roquet extremus (Garman)

Barbados.

A color race only.

Anolis opalinus Gosse

Jamaica.

A rather rare, woodland species, most often seen in western Jamaica.

Anolis iodurus Gosse

Jamaica.

A beautiful and not uncommon little woodland species. It is found widely distributed on the Island.

Anolis grahami grahami Gray

Jamaica.

Common in the woods of eastern Jamaica.

Anolis grahami conspersus Garman

Grand Cayman.

It is not common.

Norops ophiolepis (Cope)

Cuba and Isle of Pines.

A common terrestrial species usually found hiding in the heavy tufts or bunches of pasture grasses.

Cyclura figginsi Barbour

Bitter Guana Cay, near Great Guana Cay, Exuma group.

This little colony is now, I learn, almost certainly exterminated.

Cyclura portoricensis Barbour

Puerto Rico.

Extinct but relatively recent bones found in several caves.

Cyclura mattea Miller

St. Thomas.

Recently extinct, known from recent osseous remains only.

Cyclura pinguis Barbour

Anegada.

Rare.

Cyclura cornuta cornuta (Bonnaterre)

Hispaniola, La Gonave, Petit Gonave and Beata Island.

Persisting only in isolated colonies on the larger island but common on Beata, although only old individuals are now to be seen. The eggs are dug up by feral dogs and if any young hatch they are devoured by the feral cats.

Cyclura cornuta stejnegeri (Barbour & Noble)

Mona.

Another rare species. This may be the same as *C. cornuta.*

Cyclura cornuta nigerrima (Cope)

Navassa.

Extinct. I am not sure that this was really distinct from *C. cornuta*; in fact, I rather doubt it, but material is lacking to settle the question.

Cyclura collei Gray

Jamaica.

Almost extinct. There are a few on Goat Island, off the Bushy Park property, and a few on the Cays about Montego Bay.

Cyclura carinata carinata (Harlan)

Turks Island.

Abundant still on some Cays near Turks Island and in the Caicos group.

Cyclura carinata bartschii Cochran

Booby Cay, east of Mariguana Island.

Said to be more or less intermediate between the preceding and following species.

Cyclura nuchalis Barbour & Noble

Fortune Island; North Cay, Fish Cay in Acklin's Bight. Tracks also seen on Guana Cay of the same group.

Abundant on Fish Cay but rare on the other islets of Acklin's Bight.

Cyclura rileyi Stejneger

Cays and west and south shores of the lagoon of Watlings Island; (Green Cay and White Cay).

Still common. *Cyclura cristata* Schmidt (type loc. White Cay) seems to be a synonym. Mr. Armour collected a series on Green Cay during the 1934 cruise of the *Utowana.*

Cyclura inornata Barbour & Noble

U Cay in Allen's Harbor near Highborn Cay, Bahamas.

Once widespread, no doubt now extirpated through use by the negroes for food. This was the only specimen which Maynard could find — a relict on a tiny islet.

Cyclura baeolopha Cope

Andros Island.

Reported to be considerably decreased in numbers.

Cyclura caymanensis Barbour & Noble

Cayman Brac and Little Cayman.

Reported still to be not uncommon.

Cyclura macleayi Gray

Cuba and Isle of Pines.

Persisting in wild and inaccessible districts.

Cyclura ricordii (Duméril & Bibron)

Hispaniola.

Long known from the type only, until rediscovered by Dr. W. L. Abbott. Now known to be not uncommon in a few scattered localities in San Domingo.

Leiocephalus carinatus carinatus (Gray)

Cuba, Isle of Pines, and Cayman Brac.

Widespread about rocky shores, headlands and sea cliffs. So far as I am aware, seldom or never seen inland, certainly never in Cuba. With its tail tightly curled over its back this lizard jumps and hops about its haunts in a most unreptilian manner. The Cayman Brac specimens may represent a separate form but material is too scant to be sure.

Leiocephalus carinatus armouri Barbour & Shreve

North Bahamas.

A distinct race confined to Grand Bahama, the Abacos and nearby Cays.

Leiocephalus carinatus coryi Schmidt

Bemini Islands.

A small race related to *L. c. armouri.*

Leiocephalus carinatus hodsdoni Schmidt

Long Island.

Another Bahaman race quite distinct and related to the two forms mentioned above.

Leiocephalus carinatus punctatus Cochran

Acklin's Island, Crooked Island and the Cays in Acklin's Bight.

A good, distinct form, probably a species rather than a subspecies.

Leiocephalus carinatus picinus Barbour & Shreve

Atwood's Cay, Bahamas.

An apparently strictly localized form.

Leiocephalus carinatus helenae Barbour & Shreve

Mira por vos Cays.

Another very local race.

Leiocephalus carinatus virescens (Stejneger)

Green Cay, Bahamas.

Known from the type series.

Leiocephalus carinatus varius Garman

Grand Cayman.

I have been several times to Grand Cayman for short visits and never saw this species at all. Its allies are all companion denisons of the beach plant association.

Leiocephalus melanochlorus Cope

Hispaniola.

Known from Jeremie in southwest Haiti to Puerto Plata in northern San Domingo.

Leiocephalus schreibersii (Gravenhorst)

Hispaniola.

A common species on Haiti. We have not seen it from San Domingo.

Leiocephalus personatus personatus (Cope)

Hispaniola.

Allied to *L. cubensis.* Miss Cochran informs me that the typical race of this species is from southwestern Haiti. I suspect *L. lherminieri* (Duméril & Bibron) to be a synonym of this species. It was said to have come from Trinidad and Martinique, L'herminier, and Plée collectors, but both these gentlemen caused confusion on more than one occasion by either labelling their material incorrectly or else by shipping the results of a visit to several islands home to Paris in one lot shipment, after receipt of which the whole consignment was entered in the records of the Jardin des Plantes as having been *collected* at the point of shipment. This sort of thing has caused confusion for modern workers on a host of occasions.

Leiocephalus personatus aureus Cochran

Haiti.

Known only from the region about Jacmel.

Leiocephalus personatus mentalis Cochran

San Domingo.

Apparently confined to the eastern portion of the Republic.

Leiocephalus personatus scalaris Cochran

Haiti.

From the wet, heavily forested part of northern Haiti.

Leiocephalus personatus louisae Cochran

Saona Island.

Confined to this small island.

Leiocephalus eremitus Cope

Navassa.

Not found by Beck or the Clench party last year. Cats and dogs, now feral, may be to blame for the disappearance of this and other species.

Leiocephalus cubensis Gray

Cuba and Isle of Pines.

The common lizard of the canefields. I believe all species with similar habits are highly beneficial in controlling insects which are injurious to the cane.

Leiocephalus greenwayi Barbour & Shreve

Plana Cays, Bahamas.

A very distinct form abundant on East Plana Cay, and probably the same form occurs on the western island.

Leiocephalus psammodromus Barbour

Turks Island.

A common species and one which I at first called *L. arenarius* but found that that name had been obscurely given by Tschudi to a Peruvian species that apparently had escaped all notice of subsequent authors.

Leiocephalus raviceps Cope

Cuba.

I once doubted the validity of this species but it seems to be really well defined and confined to eastern Cuba.

Leiocephalus loxogrammus loxogrammus (Cope)

Rum Cay, Bahamas.

This species will probably prove to be much more widespread than we now know it to be.

Leiocephalus loxogrammus parnelli Barbour & Shreve

Watlings Island, Bahamas.

A well defined local race.

Leiocephalus macropus Cope

Cuba.

A species found abundantly throughout the Province of Oriente but, so far as we now know, not westward of, let us say, a vertical line drawn north and south and passing about through Holguin.

Leiocephalus inaguae Cochran

Great Inagua.

Common around the coastal region of the island.

Leiocephalus semilineatus Dunn

Hispaniola.

Known only from Thomazeau, Haiti.

Leiocephalus barahonensis Schmidt

Hispaniola.

Known only from the southeastern portion of San Domingo.

Leiocephalus beatanus Noble

Beata Island.

Common and the only representative of the genus which either Noble or I was able to find on the Island.

Leiocephalus vinculum Cochran

Gonave Island, Haiti.

Apparently far from abundant — at least about Anse a Galets.

Hispaniolus pratensis Cochran

Hispaniola.

Taken by Milles at St. Michel, Haiti.

Family ANGUIDAE

Celestus de la sagra de la sagra (Cocteau)

Western and central Cuba.

A widespread but excessively rare and perhaps disappearing species.

Celestus de la sagra nigropunctata Barbour & Shreve

Eastern Cuba.

A well defined color variant.

Celestus rugosus Cope

Hispaniola.

Whether or not this species is really valid remains to be determined when more material comes to hand.

Celestus costatus (Cope)

Hispaniola.

This species may be the same as *C. occiduus* of Jamaica. These species all change greatly during growth and are rather in confusion taxonomically.

Celestus badius Cope

Navassa.

This species may still occur on Navassa. I have a specimen taken but a few years ago. It may be identical with *C. costatus.*

Celestus maculatus (Garman)

Cayman Brac.

A rather poorly defined but, I think, valid form apparently known from the type only.

Celestus occiduus (Shaw)

Jamaica.

A form which was once common and of which old adults reached a great size— like Tiliqua of Australia or Corucia of the Solomon Islands. No such giants now occur and the species is rare.

Celestus impressus Cope

Jamaica.

A smaller and commoner species than *C. occiduus* but still one of which we know very little.

Celestus pleii (Duméril & Bibron)

Puerto Rico.

A species which is much like its Cuban congener but abundant rather than rare.

Sauresia sepoides Gray

Hispaniola.

I once sunk this genus into Celestus but the consensus of opinion is that I was wrong. It seems really to be not uncommon.

Wetmorena haetiana Cochran

Hispaniola.

Known from a few examples taken by Wetmore in the higher regions of the La Selle massif in Haiti.

Family XANTUSIIDAE

Cricosaura typica (Gundlach & Peters)

Cuba.

Confined to the area, of a few square miles at most, between Belig and Cabo Cruz, Oriente, Cuba.

Family TEIIDAE

Kentropyx intermedius Gray

Northern South America, Barbados.

This species apparently was formerly common on Barbados but it is now wholly extinct on that Island. Garman named (*K. copei*) but did not describe this species. I have recently seen material from Demarara and there is no doubt as to the identity of the Barbados lizards with those from British Guiana. It may have been artificially introduced into Barbados.

Ameiva aquilina Garman

St. Vincent and Grenada.

Extinct on St. Vincent but still persisting on Grenada.

Ameiva fuscata Garman

Dominica.

Owing to the absence of the mongoose this, the finest of all the Antillean Ameivas, is still a common species.

Ameiva cineracea Barbour & Noble

Guadeloupe.

Extirpated except for a few individuals which persist on the tiny islets off the coast.

Amieva atrata Garman

Redonda.

A black species superficially like *A. corvina* and living under similar conditions. It has not been collected recently, probably only because the Island is now almost never visited.

Ameiva pluvianotata Garman

Montserrat.

I have just learned that this species is still very common all over the Island.

Ameiva erythrops Cope

St. Eustatius.

Peters found this form abundant in 1922.

Ameiva griswoldi Barbour

Antigua, Nevis and Barbuda.

Extinct on Nevis, it is also almost gone on Antigua where it persists only right in the town of St. John in yards and gardens. Mr Parker has recently let me see ground lizards from Barbuda which he believes belong to this species. I think he is correct but the material is not exactly comparable.

Ameiva erythrocephala (Daudin)

St. Kitts.

Extirpated from the wilder parts of the Island; it still occurs in the gardens and yards of Basseterre. Here it is safe from the mongoose.

Ameiva garmani Barbour

Anguilla.

This species is still abundant. It is closely allied to *A. pleii.*

Ameiva pleii Duméril & Bibron

St. Barts and St. Martin.

We have again no recent information to indicate that this is not still an abundant species.

Ameiva corvina Cope

Sombrero.

A black form which, like so many Lacertids and some species of Cnemidophorus and indeed another Ameiva, has this peculiar coloration associated with isolation on a very small, arid, sunbaked and rocky island.

Ameiva polops Cope

St. Croix.

Extinct, but very few specimens have been preserved.

Ameiva wetmorei Stejneger

Puerto Rico.

Rare and confined to the arid zone about Guanica. This species also belongs to the lineolata-maynardi-polops stock, which thrives only in arid areas.

Ameiva eleanorae Grant and Roosevelt

Caja de Muertos.

A rather ill-defined form confined to this tiny islet off the coast of Puerto Rico.

Ameiva maynardi maynardi Garman

Great Inagua.

A beautiful species of the *A. lineolata* series, north and west coasts of Inagua. *A. leucomelas* Cope 1894 is a synonym.

Ameiva maynardi uniformis Noble & Klingel

Great Inagua.

Found commonly from Southwest Point to Couch Shell Point, replacing the typical form.

Ameiva maynardi parvinaguae Barbour & Shreve

Little Inagua.

A form of well marked and peculiar coloration.

AMEIVA ALBOGUTTATA Boulenger

Mona Island.

According to recent accounts still abundant. Closely related to the Puerto Rican form next following.

AMEIVA BIRDORUM Grant

Diablo Key near Fajardo, Puerto Rico.

A good, distinct form confined to a tiny island of but about ten acres, but what a horrid name it bears!

AMEIVA EXSUL Cope

St. Thomas, Water Island, St. John, St. James, Peter Island, Buck Island, Guana Island, Vieques, Anegada, Tortola, Anguilla, St. Croix and Puerto Rico.

Now exterminated on St. Thomas. I have always doubted the St. Croix record. It is common where it still occurs at all.

AMEIVA VITTIPUNCTATA Cope

Hispaniola.

A very beautiful and apparently not very common form.

AMEIVA TAENIURA Cope

Hispaniola.

When Dr. Noble and I prepared our Revision of Ameiva in 1915, I think I was principally to blame for concluding that this species was the young of *A. lineolata*. Miss Cochran has shown that this is untrue and that the species is perfectly valid.

AMEIVA CHRYSOLAEMA CHRYSOLAEMA Cope

Hispaniola, La Gonave.

A very common and widely spread species. A large series taken last year at Anse a Galets, La Gonave Island.

Ameiva chrysolaema abbotti Noble

Beata Island.

Common on this beautiful and usually uninhabited Island.

Ameiva chrysolaema juliae Cochran

Haiti, Isle Tortue.

Ameiva barbouri Cochran

La Gonave Island: La Source.

Taken only by Eyerdam in 1927. I did not find it when on La Gonave in 1929 and November, 1934. Although I secured a great number of Ameivas, all were *A. chrysolaema chrysolaema.*

Ameiva thoracica Cope

Bahama Islands.

Now known to be widespread in the northern and central portion of the Bahama archipelago.

Ameiva dorsalis Gray

Jamaica.

Formerly abundant, then, after the mongoose came, pretty well reduced — almost exterminated. Now recovering slightly in numbers in the cities and settlements where the mongoose population is kept in hand.

Ameiva auberi Cocteau

Cuba and Isle of Pines.

Nowhere abundant but very widely distributed. Perhaps most frequently seen along railway embankments.

Ameiva rosamondae Cochran

Saona Island.

A most beautiful and very distinct species. The most brilliantly colored of the entire genus. It is distinctly a rare form.

Ameiva beatensis Noble

Beata Island.

I found this species much less common than *A. chrysolaema abbotti* on recent visits to Beata.

Ameiva navassae Schmidt

Navassa.

Known from the type only, taken by R. H. Beck in 1917. Not found by the last collectors in 1930.

Scolecosaurus alleni alleni (Barbour)

Grenada.

A distinct and not uncommon species of the wet spice gardens. This little creature is most commonly found under heaps of half decayed cocoa pods.

Scolecosaurus alleni parviceps Barbour

Cannouan Island.

Known from a single specimen taken by Dr. David Fairchild while on the *Utowana*. The genus probably occurs on all the Grenadines.

Gymnophthalmus pleii Bocourt

St. Lucia and Martinique.

Extinct on Martinique. Excessively rare on St. Lucia.

Whether *G. luetkenii*, also of Bocourt, from "St. Lucia" is really distinct or whether it ever came from St. Lucia will, in part, be solved finally only by examination of the type. Only *pleei* was found on these two islands by Garman, who took a good series before it was exterminated. Parker, who records the one specimen taken in 1932, remarks that its characters tend to confirm the supposition that there is only one West Indian species.

Family AMPHISBAENIDAE

Cadea palirostrata Dickerson

Isle of Pines.

A very distinct and abundant species.

Cadea blanoides Stejneger

Cuba.

Rare and confined to Matanzas, Havana and Pinar del Rio Provinces.

Amphisbaena fenestrata Cope

Tortola, St. Thomas, St. Croix and St. John.

This form may be found to be still more widely distributed.

Amphisbaena bakeri Stejneger

Puerto Rico.

Rare and local.

Amphisbaena caeca Cuvier

Puerto Rico.

Common.

Amphisbaena manni Barbour

Hispaniola.

This form seems to be about equally abundant with innocens.

Amphisbaena innocens Weinland

Hispaniola.

Not uncommon in Haiti.

Amphisbaena cubana Peters

Cuba.

Common in Central Cuba. Best found by following plows.

Amphisbaena caudalis Cochran

Grande Cayemite Isl., Haiti.

Known from but two examples taken by Eyerdam in 1927. It is allied to *A. innocens*.

Family SCINCIDAE

Mabuya mabouia (Duméril & Bibron)

From Mexico and the Bahamas through the West Indies and on the mainland south to Trinidad and Patagonia. Absent from Cuba.

Any number of races have been recognized and named from time to time, some confined to single islands and others to island groups, but with large series all of these forms break down. Incipient races there are beyond doubt but apparently the inherent fluidity or variability within the species has prevented these races from becoming fixed. My friend, Professor E. R. Dunn, has revised this situation in Proc. Acad. Nat. Sci. Phila., 1935, p. 533–557. He recognizes two races within the species but statistical studies based on vastly more material are needed before one can really settle the question of races within this plastic, wide-ranging and perhaps oft artificially introduced form. Skinks are zoological tramps.

Skinks are apparently extinct on the following islands where once they were known to occur: St. John, St. Lucia, St. Vincent, Grenada, Barbados, Martinique.

Mabuya lineolata Noble & Hassler

San Domingo.

A fine distinct species which has recently been found. It must be very rare to have eluded collectors for so long. The mongoose is abundant in San Domingo to be sure, but the early collectors all failed to find the skink.

Suborder OPHIDIA

Family TYPHLOPIDAE

Typhlops tenuis Salvin

Mexico, Guatemala and Andros Island.

Rosén got what he called this species at Mastic Point in 1910. I have never felt very sure that it was not an undescribed form wrongly identified.

Typhlops rostellatus Stejneger

Puerto Rico.

Seems to be related to *T. dominicana*. Perhaps other species remain to be uncovered in the Lesser Antilles.

Typhlops richardii Duméril & Bibron

St. Thomas, Tortola, St. John.

Typhlops pusillus Barbour

Hispaniola.

Not uncommon in Haiti.

Typhlops dominicana Stejneger

Dominica and Guadeloupe.

The specimens from Martinique should belong here, one would suppose, rather than to *T. jamaicensis*. More material is highly desirable from all of the islands.

Typhlops platycephalus Duméril & Bibron

Puerto Rico, Vieques, Culebra, Caja de Muertos, Cayo Luis Peña.

Apparently fairly well differentiated though long confused with *T. jamaicensis*.

Typhlops sulcatus Cope

Navassa.

May not really be a valid species. It has not been found by the recent collectors.

Typhlops jamaicensis (Shaw)

Jamaica.

A common form.

Typhlops monensis Schmidt

Mona Island.

Member of the *T. lumbricalis* series.

TYPHLOPS LUMBRICALIS (Linné)

Cuba, Hispaniola, Andros, New Providence and Abaco.

Common everywhere and no doubt fortuitously introduced into the Bahamas.

TYPHLOPS GRANTI Ruthven & Gaige

Caja de Muertos, 18 miles off Ponce, Puerto Rico.

Family LEPTOTYPHLOPIDAE

LEPTOTYPHLOPS ALBIFRONS (Wagler)

Watlings Island, Antigua, Grenada and with a wide range in tropical America:

This tiny burrowing snake has an erratic distribution and has probably been carried about by primitive man, being occasionally introduced with material intended for garden planting.

LEPTOTYPHLOPS BILINEATA (Schlegel)

Martinique, St. Lucia, Guadeloupe and Barbados.

This, another tiny species, may have a considerably wider range among islands than we now know.

Family BOIDAE

EPICRATES ANGULIFER Bibron

Cuba and Isle of Pines.

Formerly common everywhere, now confined to the wilder regions, although individuals occasionally stray into the cultivated areas. The great extension of cane cultivation has decimated this species. Every cane cutter carries a machete all the time and uses it on every snake.

EPICRATES STRIATUS STRIATUS (Fischer)

Hispaniola.

This form seems to be really uncommon.

Epicrates striatus strigilatus (Cope)

Andros and New Providence in the Bahamas.

The fowl snake of the Bahamas was formerly abundant and may still be found but it is ruthlessly killed by the natives on account of its fondness for poultry. Stull believes these two forms to be separable.

Epicrates striatus chrysogaster (Cope)

Turks Island.

Of this form I have no recent information, except that it is said to be rather common on some of the Turks Island Cays.

Epicrates striatus relicquus (Barbour & Shreve)

Sheep Cay off Gt. Inagua Island, Bahamas.

This is no doubt the extirpated boa of Great Inagua, persisting on this islet to which no feral animals have been carried. Perhaps the trinominal best suggests the affinity of this distinct form.

Epicrates inornatus inornatus (Reinhardt)

Puerto Rico.

Now a really rare species and one which is related to the large boas of Cuba, Jamaica, and Hispaniola.

Epicrates inornatus granti Stull

Tortola and Guana Island.

Known from the single specimen taken by Major Chapman Grant on Tortola. He learned that it occurs in the rocky cliffs of Guana Island also.

Epicrates fordii fordii (Günther)

Hispaniola.

A very rare snake, which is noteworthy since generally speaking Antillean boids are abundant, except where artificially reduced in number. Possibly the mongoose is responsible for its rarity but it seems to have seldom been collected even before the introduction of the mongoose into Hispaniola.

Epicrates fordii monensis Zenneck

Mona.

A very little-known species but one which I believe to be most closely allied to E. fordii. This combination of names is by Stull, the most recent reviser of the Boidae.

Epicrates subflavus Stejneger

Jamaica.

I had supposed this species gone in Jamaica itself but Mr. Frank Cundall of the Institute of Jamaica at Kingston has one alive, from the southeast part of the Island. It persists on Goat Island off the south coast, in small numbers.

Epicrates gracilis (Fischer)

Hispaniola.

I have never seen a specimen of this form in all the Haitian material which has passed through my hands. As described it has a very peculiar and unique color pattern but modern material would be very welcome.

Boa cookii grenadensis (Barbour)

Grenada.

I may not have been justified in separating this form from *B. cookii*. I am, however, inclined to believe that it is fairly well differentiated and stabilized.

Boa hortulana Linné

St. Vincent, Grenada, The Grenadines and Trinidad, widespread on the mainland.

The species still occurs on Grenada and may, being arboreal, persist on St. Vincent. This, however, I am inclined now to doubt.

Constrictor constrictor orophias (Linné)

St. Lucia, Dominica.

The "tête chien" is rare on St. Lucia but still occurs — and even, occasionally at least, eats a mongoose. On Dominica it is less uncommon. There is a Zoological Park (Phila.) record for St. Kitts

which I believe to be incorrect; captive snakes get carried far and wide and dealers convey notoriously inaccurate locality records. There are also records from Trinidad but my friend, Mr. Urich, a most competent resident authority, told me that the species does not occur in Trinidad. It is confined to two islands only.

Tropidophis maculatus maculatus (Bibron)

Western Cuba and Isle of Pines. Found sparingly in western Cuba and the Isle of Pines.

I follow Miss Stull's conclusions in the taxonomy of this genus.

Tropidophis maculatus pilsbryi Bailey

Central and Eastern Cuba.

Bailey has recently described this form on a number of specimens from the mountains of Santa Clara and Oriente provinces.

Tropidophis maculatus jamaicensis Stull

Jamaica.

Excessively rare, almost extinct, since the introduction of the mongoose.

Tropidophis maculatus haetianus (Cope)

Hispaniola, La Gonave and Isle Tortue.

Not uncommon all over the Island.

Tropidophis pardalis pardalis (Gundlach)

Cuba and Isle of Pines.

The Abaco records which have caused such worry were evidently due to the wrong copying of field data by me. (Cf. Bailey Proc. New Eng. Zool. Soc., Vol. 16, 3 May, 1937, p. 46).

Tropidophis pardalis canus (Cope)

Great Inagua, Eleuthera Islands, Cat Island, and Long Island.

Common on Eleuthera but now very rare on Inagua.

Tropidophis pardalis curtus (Garman)

New Providence, Bahamas.

A common form. It occurs under stones of walls and in the rocks heaped about the orange trees. Since it at times sallies forth after heavy rains, it is locally called "thunder snake." Like all its congeners, it is nocturnal.

Tropidophis pardalis barbouri Bailey

Eleuthera, Cat and Long Island, Bahamas.

My colleague Shreve and I considered describing this species but he did not consider it sufficiently distinct. It is, however, valid if not strikingly well defined.

Tropidophis pardalis androsi Stull

Andros Island.

Apparently abundant but I have never happened to see a specimen.

Tropidophis pardalis greenwayi Barbour & Shreve

Ambergris Cay, Caicos Island.

Probably widespread in this group of islands.

Tropidophis bucculentus (Cope)

Navassa.

Known from but three specimens, it has not been found by recent expeditions. Bailey believes that this represents a distinct species and not a sub-species of pardalis as Stull concluded.

Tropidophis wrighti Stull

Cuba.

Known, so far as I am aware, from the type only. This was taken by Charles Wright, the botanist, who collected for a long time in the Guantanamo Basin and, I think, nowhere else in Cuba.

Tropidophis nigriventris Bailey

Camaguey Prov., Cuba.

Just described and known as yet from but two specimens.

Tropidophis melanurus (Schlegel)

Cuba and Isle of Pines.

The largest member of the genus, reaching a length of nearly a yard. It is abundant and widespread. It feeds on frogs, lizards and birds. Although more inclined to be arboreal than the other species of the genus, it is equally nocturnal and perhaps the most abundant of them all.

Tropidophis semicinctus (Gundlach & Peters)

Cuba.

Widespread but distinctly uncommon.

Family COLUBRIDAE

Natrix compressicauda Kennicott

Cuba, Florida Keys, extreme southwestern Florida.

My finding this species in mangroves near Caibarien on the north coast of Cuba established the specific identity of the excessively rare Cuban Natrix and relegated several long questioned names to a definite synonymy.

Tretanorhinus variabilis variabilis Duméril & Bibron

Cuba.

Not uncommon in fresh-water ponds and rivers. A nocturnal species. Its mainland ally, *T. nigroluteus,* is rather partial to mangrove swamps.

Tretanorhinus variabilis insulae-pinorum (Barbour)

Isle of Pines.

This species seems to have regularly 19 rows of scales while the Cuban snakes have 21. This is, at first sight, a trivial character but one which is apparently really diagnostic.

Drymobius boddaerti bruesi (Barbour)

St. Vincent and Grenada.

Extinct on St. Vincent but still to be found on Young's Island off its coast and very rare in Grenada. Mr. Shreve believes that with more material from Young's Island another race might be named. My friend, Mrs. Gaige, advised me to resurrect my name bruesi for this race which I first applied with the idea that the Grenadian snake was an Alsophis.

Uromacer oxyrhynchus Duméril & Bibron

Hispaniola and Isle Tortue.

A form found all over the Island, i.e., both Haiti and San Domingo. I have seen it from Port au Prince and Samana.

Uromacer frenatus (Günther)

Hispaniola and Isle Tortue.

We now have a fine series of this species.

Uromacer wetmorei Cochran

Beata Island.

A valid form related to the preceding.

Uromacer catesbyi (Schlegel)

Hispaniola and La Gonave.

A widespread but rather rare species.

Uromacer scandax Dunn

Isle Tortue, near Haiti.

An abundant ally of *U. catesbyi.*

Uromacer dorsalis Dunn

La Gonave Island.

Apparently a derivative of the Haitian *U. frenatus.*

Alsophis anomalus (Peters)

Hispaniola and Isle Tortue.

I have but little information to give concerning this species. Dr. G. M. Allen took one at Port au Prince in 1919. I took one on Isle Tortue during the *Utowana* cruise of 1934, besides which I have received no other recent specimens.

Alsophis leucomelas leucomelas (Duméril & Bibron)

Guadeloupe and Marie Galante.

Extinct on both islands.

Alsophis leucomelas sanctorum (Barbour)

Les Saintes Is. near Guadeloupe.

No doubt abundant still.

Alsophis leucomelas sibonius (Cope)

Dominica.

With no mongoose on this island, the species should be abundant still. There are still great areas of wild land on Dominica.

Alsophis leucomelas manselli Parker

Montserrat.

Still to be found.

Alsophis leucomelas antiguae Parker

Antigua.

Extinct.

Alsophis sanctae-crucis Cope

St. Croix.

Extinct.

Alsophis melanichnus Cope

Hispaniola.

We await more information concerning this snake with great interest. Its non-appearance in any of the collections which have come before me is perhaps indicative that it is fast disappearing.

Alsophis ater (Gosse)

Jamaica.

Very rare indeed. A species which has suffered fearfully from the ravages of the mongoose. Dunn has shown that this is related to *A. melanichnus* Cope of Haiti.

Alsophis rijgersmaei Cope

St. Martins, St. Barts and Anguilla.

No herpetologist has visited St. Martins in recent years, but Dunn has re-examined the types and considers that Garman's name of *Alsophis cinereus* cannot stand as valid.

Alsophis variegatus (Schmidt)

Mona Island.

Probably still abundant.

Alsophis portoricensis (Reinhardt & Lütken)

Puerto Rico, Desecheo and Caja de Muertos Island.

A distinctly rare form.

Alsophis anegadae Barbour

Anegada.

I still feel that this form warrants recognition as valid. Its peculiar pattern is characteristic of every Anegada specimen which I have seen, even though it occurs very sporadically elsewhere, where other patterns are the place mode.

Alsophis antillensis (Schlegel)

Vieques, St. Thomas, St. James, Salt Island, Peter Island, St. John, Tortola, Virgin Gorda, Culebra, Pinero and Dog Island.

Extinct on St. Thomas, rare on Puerto Rico, elsewhere abundant. Major Grant doubts the records for Puerto Rico.

Alsophis rufiventris (Duméril & Bibron)

Saba, St. Kitts, St. Eustatius and Nevis.

Still abundant on Saba and St. Eustatius but extinct on the other two islands.

Alsophis vudii vudii Cope

Bahama Islands.

This racer is common throughout most of the middle group of Bahama Islands: — New Providence, Eleuthera, Long Island, Green Cay, the Exuma Cays, Andros Ids. and no doubt upon many others.

Alsophis vudii aterrimus Barbour & Shreve

Grand Bahama.

A black racer, not brown or grayish, perhaps confined to this little-known island.

Alsophis vudii picticeps Conant

Bimini Islands.

Related to the two preceding races but well defined.

Alsophis vudii raineyi Barbour & Shreve

Crooked Isl., Bahamas.

A well defined local form.

Alsophis vudii utowanae Barbour & Shreve

Sheep Cay off Great Inagua Isl., Bahamas.

Another distinct relict on Sheep Cay which was no doubt common on Great Inagua before the introduction of so many domesticated animals which have become feral.

Alsophis angulifer angulifer (Bibron)

Cuba and Isle of Pines.

A very common species in all open plains, pastures and savannas.

Alsophis angulifer fuscicauda (Garman)

Cayman Brac, and Little Cayman.

A well defined race. Mr. Roger Conant has recently shown me a specimen from Little Cayman, which he has recorded recently. (Proc. New Eng. Zool. Club, Vol. 16, Oct. 4, 1937, p. 81).

Alsophis angulifer caymanus (Garman)

Grand Cayman.

I have never seen sufficient material to decide whether this form is really different from that of Cuba.

Dromicus andreae andreae (Reinhardt & Lütken)

Cuba.

A common snake at pastures and open fields. I follow Professor E. R. Dunn in suppressing the genus Leimadophis.

Dromicus andreae nebulatus (Barbour)

Isle of Pines.

Another common form. It is closely related to the foregoing species, indeed closely similar specimens occur also in extreme eastern Cuba. We should probably recognize three races or abandon this name.

Dromicus callilaemus Gosse

Jamaica.

Small and more retiring, this species is not so near extermination as *L. ater*. Nevertheless it is a distinctly rare snake.

Dromicus funereus Cope

Jamaica.

This form long buried in the synonymy has been shown by Major Grant to be valid. Dr. Stejneger agrees. Two out of the three original types has been found in Washington.

Dromicus juliae juliae (Cope)

Dominica.

Probably still not uncommon.

Dromicus juliae copeae Parker

Guadeloupe.

Extinct.

Dromicus melanotus (Shaw)

Grenada, Trinidad and Venezuela.

Extinct apparently on Grenada but common elsewhere.

Dromicus perfuscus Cope

Barbados.

Extinct.

Dromicus mariae (Barbour)

Marie Galante.

Extinct.

Dromicus ornatus (Garman)

St. Lucia.

Extinct.

Dromicus cursor (Lacépède)

Martinque.

Extinct.

Dromicus anegadae (Barbour)

Anegada.

We have no recent information concerning this form but no reason to suppose that it is not still abundant.

Dromicus exiguus Cope

St. Thomas, St. John, Tortola and Just van Dyke, and Hassel Il.

Extinct on St. John and St. Thomas, it is not uncommon on the other islands. Major Grant doubts the Culebra records.

Dromicus stahli (Stejneger)

Puerto Rico.

Still not uncommon, widely distributed and confined to this Island.

Dromicus alleni (Dunn)

La Gonave Island.

A distinct and striking island form.

Dromicus parvifrons parvifrons (Cope)

Hispaniola.

One of several races which appear to be common, reasonably well localized in southwest Haiti and probably valid.

Dromicus parvifrons niger (Dunn)

Hispaniola.

This form inhabits most of San Domingo.

Dromicus parvifrons protenus (Jan)

Hispaniola.

A common widespread form. Known from many localities in northern and central Haiti and the higher plateau of San Domingo.

Dromicus parvifrons lincolni (Cochran)

Beata Island.

A slightly differentiated form.

Dromicus parvifrons tortuganus (Dunn)

Isle Tortue.

Another well marked form of which we took a good series during the visit of the *Utowana* to this island in 1934.

Dromicus parvifrons rosamondae Cochran

Isle Vache.

A fairly well defined form based on a good series of specimens.

Hypsirhynchus ferox Günther

Hispaniola.

This species is strictly nocturnal and oviparous. In my experience, it is restricted apparently to the Cul de Sac area not far from Port au Prince. Dunn has discarded the genus Hypsirhynchus. I believe that this sluggish, nocturnal form is well worthy of generic distinction.

Arrhyton taeniatum Günther

Cuba.

An uncommon species, like its fellow, found by day under stones or while plowing. At night it is sometimes met with abroad.

Arrhyton redimitum (Cope)

Eastern Cuba.

Material recently received has proved the validity of this form, so Mr. Benjamin Shreve assures me.

Arrhyton vittatum (Gundlach & Peters)

Cuba.

These snakes are probably allies of Contia of the mainland.

Darlingtonia haetiana Cochran

Haiti.

An extraordinary new genus recently found by Dr. Darlington of Harvard at Roche Croix, in the northeastern foothills of Morne La Hotte, at 5,000 ft. altitude. Its affinity may be with the preceding genus but it is very well defined.

Pseudoboa cloelia (Daudin)

Dominica, St. Lucia, Grenada, Trinidad and tropical America generally.

This species is surely extinct in St. Lucia, probably excessively rare on Grenada and its status on Dominica is still, no doubt, unchanged. I have never, however, seen or heard of recent specimens from any of the islands. Nevertheless, I think the records are really based on valid wild-caught specimens.

Pseudoboa neuweidii (Duméril & Bibron)

Grenada, Trinidad and with a wide range in tropical America.

Garman took three examples on Grenada during the Blake Expedition about 1883. So far as I can learn it has never been taken before or since.

Ialtris dorsalis (Günther)

Hispaniola, Isle Vache.

A large and uncommon species which has been found in both Haiti and San Domingo. It seems to have no close allies among Antillean reptiles and to be very rarely collected indeed.

Ialtris parishi Cochran

Haiti.

Known only from southwestern Haiti.

Family CROTALIDAE

Bothrops atrox (Linné)

Martinique and St. Lucia.

Whatever may be the origin of the Fer-de-lance's appearance on these islands, one thing Amaral has definitely proved — the snake is the common wide-ranging form of tropical America.

Order CHELONIA

Family TESTUDINIDAE

Testudo tabulata Walbaum

Tropical South America, feral on Lovango Cay and Water Island, near St. Thomas.

Carried, from time to time, to most of the islands from South America. Not a native element of the Antillean fauna.

Family EMYDIDAE

Pseudemys felis Barbour

Cat Island.

I wonder if the significance of the finding of a Pseudemys in the Bahamas has been fully appreciated. It seems to me that in this connection the following facts are worthy of note.

There are innumerable mangrove swamps throughout the archipelago. These would be suitable homes for Malaclemys but none are to be found. Malaclemys, confined to salt water marshes and mangrove swamps, are, or were but a few years ago, abundant from Cape Cod to the Florida keys. Pseudemys, so far as I know, never goes into salt or brackish water and yet, of the innumerable islands of the Bahamas, there's only one which has a few poor little fresh water ponds, or perhaps better mud holes, in which it supports a very considerable population of Pseudemys whose habits have become highly specialized to meet the peculiar conditions under which they live.

What the mathematical probability would be which would bring these ponds and Pseudemys together by, let us say, the carrying of young turtles by a hurricane is, of course, utterly incalculable. It seems to me that some more plausible reason must be found for their being there. Perhaps not long ago when the Bahamas were higher there were larger lakes, more of them and more Pseudemys. What we see now, unsuspected until a few years ago, no doubt represents another disappearing remnant of fauna and of these there are many in the Antilles.

It is still a little difficult to figure how Pseudemys got into these ponds even if they were once much larger, for fresh water turtles seem to be particularly unfitted for chance dispersal. It is hard to believe that they swam over, if no Malaclemys ever has. That looks as if such turtles did little sea swimming and that they were picked up by winds of hurricane force and dumped in a place where they could survive seems to presuppose a toughness of fiber on the part of the turtle which is contrary to our knowledge of the beasts and again the mathematical chances against picking up, carrying and then not landing in an unfavorable spot would, I should suppose, be millions to one. The Cat Island turtle is, I believe, rather better differentiated than are the turtles of the several different Greater Antilles on which they occur.

Pseudemys decussata Gray

Cuba.

What, I believe, to be the undoubted type, in the British Museum, has been photographed by Mr. Parker and I feel reasonably sure that this represents a Cuban form. The type localities for this and the following form are unknown.

Pseudemys rugosa Shaw

Cuba.

Thanks to Dr. Stejneger and Mr. Parker I have photographs of the type in the Museum of the Royal College of Surgeons and suspect this also to be a Cuban species.

Pseudemys stejnegeri Schmidt

Puerto Rico.

A small, possibly distinct form.

Major Grant doubts the validity of this species. I am inclined to agree with him but let it stand, pending a general revision of the turtles of all the islands which I hope to undertake, or help someone else do, when I have much more material.

Pseudemys ssp.

Cuba, Haiti, Jamaica.

There are other pond turtles on these islands but their systematic status is as yet in doubt.

Order LORICATA

Family CROCODYLIDAE

Crocodylus rhombifer Cuvier

Cuba and Isle of Pines.

Found in the Zapata Swamp in Cuba and no doubt still also in the Cienaga of the Isle of Pines. Specimens more than six feet long are now much less often seen than a generation ago.

Crocodylus acutus Cuvier

Cuba, Jamaica, and Hispaniola; as well as extreme southern Florida and the Keys and Central America.

Crocodylus intermedius Graves

Orinoco Basin.

Accidental in Grenada, September 6, 1910.

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LIST OF THE FISHES, TYPES OF POEY, IN THE MUSEUM OF COMPARATIVE ZOÖLOGY

By Luis Howell y Rivero

Museo Poey

University of Havana

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No. 3. — *List of the Fishes, Types of Poey, in the Museum of Comparative Zoology*

By Luis Howell y Rivero

INTRODUCTION

The present paper presents a list of some of the types of fishes described by Felipe Poey, viz. those which are deposited in the collection of the Museum of Comparative Zoölogy.

Felipe Poey (1799–1891), who during his entire life studied Cuban fishes, sent to the Museum of Comparative Zoölogy, between the years 1861 and 1870, several collections of alcoholic fishes, as well as a great number of skeletons and mounted specimens. Among these were a large number of his types, and it is the purpose of this paper to discuss such of these as can at present be located.

A careful checking has been made of every specimen sent by Poey to determine which are types. I have been helped in every instance by his various publications, the original invoices which accompanied the lots, now deposited in the Library of the Museum of Comparative Zoölogy, besides many notes brought with me from Cuba. Attention is called to the fact that more than once the invoice number of the specimens sent by Poey has been taken as the original "species number," and this has caused confusion. Every species described or identified by him pertaining to the Cuban fauna as far as he knew it, bears a "species number" in all his papers, regardless of the number of specimens used or seen. The writer has a complete list of Poey's "species numbers" and these are given with each species herein as *No. Poey* after the M. C. Z. catalogue number.

In this paper, the name by which the species was described is given first, followed by the name which gives the actual status of the species. In the synonymy, reference is given to all the publications of Poey in which the species is mentioned. After this, reference is given to the original description of the species in those cases in which Poey's species is considered a synonym. Last comes the reference to the work of Jordan & Evermann (Fishes of North and Middle America, 1896–1898), as the most complete account of the fishes of the West Indies. In all possible cases reference will be given to the latest work concerning any major group or family.

To save space by avoiding a certain amount of repetition, all references have been abbreviated, giving a complete and detailed bibli-

ography at the end of the paper, where attention is called to the publication dates of the fascicules of the *Memorias* and *Repertorio* of Poey. Lack of accuracy in this matter has been the cause of more than one error.

All of the holotypes and many of the paratypes and cotypes are figured in Poey's unpublished manuscript "Ichthyology of Cuba," but some of these figures have already appeared in his various publications.

Since it is understood that the general locality is Cuba, the locality reference is omitted, except in cases where a specific locality is stated in the description, e.g. Jardin Botánico, Habana. (for *Girardinus metallicus*).

It is a satisfaction to find that of the 389 species described by Poey, the types of 188 species are here preserved. I regret to say that a few of his types are lost, although in some instances he states in his invoices or original description that he has sent them to the Museum of Comparative Zoölogy; in other cases they are cited as being in this Museum in the work of Jordan & Evermann (loc. cit.), among these *Chauliodus richardsoni* Poey, *Gramma loreto* Poey and *Physiculus kaupi* Poey. Most of the specimens sent by Poey, especially the types, are in a very good state of preservation.

In this paper, the general arrangement of the "Check List of Fishes and Fish-like Vertebrates of North and Middle America," 1930 (Bull. U. S. Fish Comm.) has been followed. All measurements given refer to the total length of the specimens, unless something else is specifically indicated.

SQUALIDAE

Etmopterus

Etmopterus Rafinesque, 1810a:14 (*Etmopterus aculeatus* Rafinesque = *Squalus spinax* Linnaeus)

1. Spinax hillianus Poey
   = Etmopterus hillianus (Poey)
   Spinax hillianus Poey, 1861:340, 359, pl. 19, fig. 13–14.
   Squalus hillianus, Poey, 1868:454.
   Spinax spinax Poey, 1876–203.
   Etmopterus pusillus, Jordan & Evermann, 1896:55.
   Etmopterus hillianus, Garman, 1913:224, pl., 10, fig. 1–4.

Holotype: M. C. Z. 1025, female. No. Poey 617.

CLUPEIDAE

Sardinia

Sardinia Poey, 1860:311 (*Sardinia pseudo-hispanica* Poey)

2. Sardinia pseudo-hispanica Poey
=Sardinia anchovia (Cuvier & Valenciennes)
Sardinia pseudo-hispanica Poey, 1860:311; 1861:384; 1868:419; 1876:148.
Sardinella anchovia Cuvier & Valenciennes, 1847:269; Jordan & Evermann, 1896:429.

Cotypes: M. C. Z. 17768 and 17771. No. Poey 34. In the first lot there are five specimens, 100 to 145 mm., the one 130 mm. long figured by Poey in his MS; the second number includes only one specimen.

Harengula

Harengula Cuvier & Valenciennes, 1847:280 (*Harengula latutus* Cuvier & Valenciennes)

3. Harengula sardina Poey
Harengula sardina Poey, 1860:310; 1861:384; 1868:418; 1876:147.
Sardinella sardina, Jordan & Evermann, 1896:430.

Holotype: M. C. Z. 17868. Paratypes: M. C. Z. 17736, two specimens 128 and 153 mm. No. Poey 40.

Chirocentrodon

Chirocentrodon Günther, 1868:463 (*Chirocentrodon taeniatus* Günther)

4. Pellona bleekeriana Poey
=Chirocentrodon bleekeriana (Poey)
Pellona bleekeriana Poey, 1867:242; 1868:419; 1876:148.
Ilisha bleekeriana, Jordan & Evermann, 1896:436.

Cotypes: M. C. Z. 17845, seven specimens in such bad condition that no measurements could be made. No. Poey 537.

ENGRAULIDAE

Anchoviella

Anchoviella Fowler, 1911:211 (*Engraulis perfasciatus* Poey)

5. ENGRAULIS PERFASCIATUS Poey
=ANCHOVIELLA PERFASCIATA (Poey)
Engraulis perfasciatus Poey, 1860:312; 1861:385; 1868:422, 460; 1876:149.
Stolephorus perfasciatus, Jordan & Evermann, 1896: 441.

Types: M. C. Z. 17955, nine specimens, 82 to 103 mm., among which the one 100 mm. long is the holotype. No. Poey 422.

6. ENGRAULIS CUBANUS Poey
=ANCHOVIELLA CUBANA (Poey)
Engraulis cubanus Poey, 1868:420, 460; 1876:149.
Stolephorus cubanus, Jordan & Evermann, 1896:442.

Types: M. C. Z. 17958, four specimens, the largest of which is the holotype. No. Poey 23.

ANCHOVIA

Anchovia Jordan & Evermann, 1896:449 (*Engraulis microlepidotus* Kner & Steindachner)

7. ENGRAULIS PRODUCTUS Poey
=ANCHOVIA CLUPEOIDES (Swainson)
Engraulis productus Poey, 1866a:380; 1868:422; 1876:149.
Engraulis clupeoides Swainson, 1839:388.
Stolephorus clupeoides, Jordan & Evermann, 1896:447.
Stolephorus productus, Jordan, & Evermann, 1896:447.

Types: M. C. Z. 17961, two specimens, the largest of which is the holotype. No. Poey 36.

CETENGRAULIS

Cetengraulis Günther, 1868:383 (*Engraulis edentulus* Cuvier)

8. ENGRAULIS BREVIS Poey
=CETENGRAULIS EDENTULUS (Cuvier)
Engraulis brevis Poey, 1866a:379; 1868:422.
Cetengraulis brevis, Poey, 1876:148.
Engraulis edentulus Cuvier, 1829:323.
Cetengraulis edentulus, Jordan & Evermann, 1896:450.

Holotype: M. C. Z. 24296. No. Poey 716.

CONGRIDAE

Conger

Conger Cuvier, 1817:231 (*Muraena conger* Linnaeus)

9. Conger esculentus Poey
=Conger conger Linnaeus.
Conger esculentus Poey, 1861:346, 385; 1867:246; 1868:424; 1876:151.
Muraena conger Linnaeus, 1758:245.
Leptocephalus conger, Jordan & Evermann, 1896:354.
Holotype: M. C. Z. 9328. No. Poey 581.

10. Echelus caudilimbatus Poey
=Conger caudilimbatus (Poey)
Echelus caudilimbatus Poey, 1867:249, pl. 2, fig. 8.
Ophiosoma caudilimbatus, Poey, 1868:424.
Conger caudilimbatus, Poey, 1876:152.
Leptoconger caudilimbatus, Jordan & Evermann, 1896:355.
Holotype: M. C. Z. 9324. No. Poey 176.

ECHELIDAE

Myrophis

Myrophis Lütken, 1851:1 (*Myrophis punctatus* Lütken)

11. Myrophis microstigmius Poey
Myrophis microstigmius Poey, 1867:250, pl. 3, fig. 4; 1868:425; 1876:153.
Myrophis punctatus, Jordan & Evermann, 1896:371.
Holotype: M. C. Z. 33440. No. Poey 653. This species has long been considered a synonym of *Myrophis punctatus* Lütken, but it proves to be distinct (Rivero, 1934:341).

OPHICHTHYIDAE

Myrichthys

Myrichthys Girard, 1859:58 (*Myrichthys tigrinus* Girard)

12. Ophisurus latemaculatus Poey
=Myrichthys oculatus (Kaup)

Ophisurus latemaculatus Poey, 1867:252, pl. 3, fig. 1; 1868:425.
Pisodonophis latimaculatus, Poey, 1876:153.
Ophichthys latimaculatus, Poey, 1880:10.
Pisoodonophis oculatus Kaup, 1856:22.
Myrichthys oculatus, Jordan & Evermann, 1896:376.

Holotype: M. C. Z. 27223. No. Poey 606.

13. Ophisurus longus Poey
=Myrichthys acuminatus (Gronow)
Ophisurus longus Poey, 1867:254; 1868:425.
Pisodonophis longus, Poey, 1876:154.
Ophichthys longus, Poey, 1880:11.
Muraena acuminata Gronow, 1854:21.
Myrichthys acuminatus, Jordan & Evermann, 1896: 377.

Holotype: M. C. Z. 9155. No. Poey 180.

Ophichthus

Ophichthus Ahl, 1787:5 (*Muraena ophis* Linnaeus)

14. Ophisurus chrysops Poey
=Ophichthus gomesii (Castelnau)
Ophisurus chrysops Poey, 1861:321, 385.
Ophichthys chrysops, Poey, 1868:425; 1876:154.
Ophisurus gomesii Castelnau, 1855:84, pl. 44, fig. 2.
Ophichthus gomesii, Jordan & Evermann, 1896:384.

Holotype: M. C. Z. 27212. No. Poey 604.

Mystriophis

Mystriophis Kaup, 1856:10 (*Ophisurus rostellatus* Richardson)

15. Conger mordax Poey
=Mystriophis intertinctus (Richardson)
Conger mordax Poey, 1860:319; 1861:385.
Macrodonophis mordax, Poey, 1867:252; 1868:425.
Crotalophis mordax, Poey, 1876:153.
Ophisurus intertinctus Richardson, 1844a:102.
Mystriophis intertinctus, Jordan & Evermann, 1896: 386.

Holotype: M. C. Z. 9220. No. Poey 339.

MURAENIDAE

Gymnothorax

Gymnothorax Bloch, 1795:83 (*Gymnothorax muraena* Bloch)

16. Gymnothorax obscuratus Poey
Gymnothorax obscuratus Poey, 1870b:320; 1876:159.
Lycodontis obscuratus, Jordan & Evermann, 1896:398.
Holotype: M. C. Z. 27217. No. Poey 736.
Type locality: Havana.

Channomuraena

Channomuraena Richardson, 1844a:96 (*Ichthyophis vittatus* Richardson)

17. Channomuraena cubensis Poey
=Channomuraena vittata (Richardson)
Channomuracna cubensis Poey, 1867:266, pl. 3, fig. 6; 1868:428.
Ichthyophis vittatus Richardson, 1844b:114, pl. 53, figs. 7–9.
Channomuraena vittata, Poey, 1876:160; Jordan & Evermann, 1896:404.
Holotype: M. C. Z. 9191. No. Poey 230.

SYNODONTIDAE

Trachinocephalus

Trachinocephalus Gill, 1861:53 (*Saurus myops* Cuvier & Valenciennes)

18. Saurus brevirostris Poey
=Trachinocephalus myops (Forster)
Saurus brevirostris Poey, 1860:305; 1861:384.
Trachinocephalus brevirostris, Poey, 1868:415; 1876:144.
Salmo myops Forster, in Bloch & Schneider, 1801:421.
Trachinocephalus myops, Poey, 1868:415; Jordan & Evermann, 1896:533.
Holotype: M. C. Z. 6895. No. Poey 488.

Synodus

Synodus Gronow, 1777:449 (*Synodus snyodus* Linnaeus)

19. Saurus spixianus Poey
= Synodus foetens (Linnaeus)
Saurus spixianus Poey, 1860:304; 1861:384.
Synodus spixianus, Poey, 1868:413; 1876:144.
Salmo foetens Linnaeus, 1766:513.
Synodus foetens, Jordan & Evermann, 1896:538.
Holotype: M. C. Z. 6884. No. Poey 588.

SUDIDAE

Sudis

Sudis Rafinesque, 1810a:60 (*Sudis hyalina* Rafinesque)

20. Paralepis intermedius Poey
= Sudis intermedius (Poey)
Parelepis intermedius Poey, 1868:416; 1876:142.
Sudis intermedius, Jordan & Evermann, 1896:600.
Holotype: M. C. Z. 32931. No. Poey 710.
Type locality: Matanzas.

MYCTOPHIDAE

Diaphus

Diaphus Eigenmann & Eigenmann, 1890:3 (*Scopelus engraulis* Günther)

21. Myctophum nocturnum Poey
= Diaphus dumerilli (Bleeker)
Myctophum nocturnum Poey, 1861:426; 1868:416; 1876:145.
Colletia nocturna, Jordan & Evermann, 1896:567.
Scopelus dumerilli Bleeker, 1856:66.
Diaphus dumerilli, Parr, 1928:126, fig. 23.
Holotype: M. C. Z. 6871. No. Poey 297.

CYPRINODONTIDAE

Rivulus

Rivulus Poey, 1860:307 (*Rivulus cylindraceus* Poey)

22. Rivulus cylindraceus Poey
Rivulus cylindraceus Poey, 1860:308; 1861:383; 1868:412; 1876:140, pl. 8, fig. 4; 1880:5, pl. 5, fig. 4; Jordan & Evermann, 1896:662; Myers, 1927:121.

Types: M. C. Z. 6423, the female being the holotype, the male paratype. Paratypes: M. C. Z. 6395. No. Poey 366.
Type locality: Arroyo Mordazo, near Habana.

CYPRINODON

Cyprinodon Lacépède, 1803b:486 (*Cyprinodon variegatus* Lacépède)

23. TRIFARCIUS FELICIANUS Poey
=CYPRINODON VARIEGATUS RIVERENDI (Poey)
Trifarcius felicianus Poey, 1868:412; 1876:140.
Trifarcius Riverendi Poey, 1856:306.
Cyprinodon felicianus, Jordan & Evermann, 1896:676.

Cotypes: M. C. Z. 6402 and 6410; in the first lot one specimen 49.4 mm. long; in the second 3 specimens 37–39.6 mm. No. Poey 719.

POECILIDAE

GAMBUSIA

Gambusia Poey, 1854:382 (*Gambusia punctata* Poey)

24. GAMBUSIA PUNCTATA Poey
Gambusia punctata Poey, 1854:384, pl. 31, fig. 18, pl. 32, fig. 5–9; 1861:383; 1868:410; 1876:140. Jordan & Evermann, 1896:676; Hubbs, 1926:35.

Cotypes: M. C. Z. 6393–6394. All the specimens in the same bottle, 22 males and 39 females. No. Poey 505.
Type locality: Rio Almendares, near Habana.

25. GAMBUSIA PUNCTICULATA Poey
Gambusia puncticulata Poey, 1854:386, pl. 31, fig. 6–7; 1861:383; 1868:410; 1876:141; Jordan & Evermann, 1896:680; Hubbs, 1926:37.

Cotypes: M. C. Z. 6391, 6401, and 6397, 12 males and 24 females. No. Poey 510.
Type locality: Moats of the old city wall of Havana City.

GLARIDICHTHYS

Glaridichthys Garman, 1896:232 (*Girardinus uninotatus* Poey)

26. GIRARDINUS UNINOTATUS Poey
=GLARIDICHTHYS UNINOTATUS (Poey)

Girardinus uninotatus Poey, 1860:309; 1861:383; 1868:411; 1876:142.
Heterandria uninotata, Jordan & Evermann, 1896:687.
Glaridichthys uninotatus, Hubbs, 1926:59.

Cotypes: M. C. Z. 6406, four males and 21 females, M. C. Z. 6243, 2 males and 4 females, M. C. Z. 6405, 3 females. No. Poey 522.

Type locality: Rio Taco Taco, Pinar del Rio.

Girardinus

Girardinus Poey, 1854:383 (*Girardinus metallicus* Poey)

27. Girardinus metallicus Poey

Girardinus metallicus Poey, 1854:387, pl. 31, fig. 8–11; 1861:383; 1868:411; 1876:141; Hubbs, 1926:60.
Heterandria metallica, Jordan & Evermann, 1896:687.

Cotypes: M. C. Z. 6407, 1 male and 10 females, M. C. Z. 6414, 7 females, and 1412a, 1 male and 13 females. No. Poey 506.

Type locality: Brook in the Botanical Garden, Habana.

Limia

Limia Poey, 1854:388 (*Limia cubensis* Poey = *Poecilia vittata* Guichenot)

28. Limia cubensis Poey
= Limia vittata (Guichenot)

Limia cubensis Poey, 1854:388, pl. 31, fig. 12–13, pl. 32, fig. 10–11; 1861:383; 1868:411; 1876:141; 1880:5.
Poecilia vittata Guichenot, in Ramon de la Sagra, 1853:146, pl. 5, fig. 1; Jordan & Evermann, 1896:692.
Limia vittata, Hubbs, 1926:75.

Cotypes: M. C. Z. 6404, 1 male and 4 females, M. C. Z. 6403, 18 males and 40 females. No. Poey 347.

Type locality: Moats of the old city wall of Havana.

29. Limia pavonina Poey
= Limia vittata (Guichenot)

Limia pavonina Poey, 1876:142.
Poecilia pavonina, Jordan & Evermann, 1896:692.
Poecilia vittata Guichenot, in Ramon de la Sagra, 1853:146, pl. 5, fig. 1; Jordan & Evermann, 1896:692.

Cotypes: M. C. Z. 6400, 2 males and 1 female. No. Poey 549.

BELONIDAE

Strongylura

Strongylura Van Hasselt, 1824:374 (*Strongylura caudimaculata* Van Hasselt = *Belone strongylura* Van Hasselt)

30. Belone notata Poey
= Strongylura notata (Poey)
Belone notata Poey, 1860:293; 1861:376; 1867:166; 1868:382; 1876:120.
Tylosurus notatus, Jordan & Evermann, 1896:710.
Holotype: M. C. Z. 32933. No. Poey 413.

Tylosurus

Tylosurus Cocco, 1829:18 (*Tylosurus contraini* Cocco = *Sphyraena acus* Lacépède)

31. Belone melanochira Poey
= Tylosurus raphidoma (Ranzani)
Belone melanochira Poey, 1860:294; 1861:376; 1868: 382; 1876:120.
Belone raphidoma Ranzani, 1842:359, pl. 37, fig. 1.
Tylosurus raphidoma, Jordan & Evermann, 1896:715.
Cotypes: M. C. Z. 624, 2 specimens 490 & 530 mm. No. Poey 541.

32. Belone crassa Poey
= Tylosurus raphidoma (Ranzani)
Belone crassa Poey, 1860:291; 1861:376; 1867:165; 1868:381; 1876:120.
Belone raphidoma Ranzani, 1842:359, pl. 37, fig. 1.
Tylosurus raphidoma, Jordan & Evermann, 1896:715.
Paratype: M. C. Z. 623; the largest of the three specimens mentioned in the original description, the median one, the holotype, missing. No. Poey 435.

33. Belone latimana Poey
= Tylosurus acus (Lacépède)
Belone latimana Poey, 1860:292; 1861:376; 1867:166; 1868:382; 1876:120.
Sphyraena acus Lacépède, 1803b:6, pl. 1, fig. 3.
Tylosurus acus, Jordan & Evermann, 1896:717.
Holotype: M. C. Z. 622. No. Poey 353.

HEMIRAMPHIDAE

Euleptorhamphus

Euleptorhamphus Gill, 1859b:156 (*Euleptorhamphus brevoorti* Gill)

34. Euleptorhamphus velox Poey

Euleptorhamphus velox Poey, 1868:383; 1876:121; Jordan & Evermann, 1896:724.

Holotype: M. C. Z. 8779. No. Poey 722.

Hyporhamphus

Hyporhamphus Gill, 1859a:131 (*Hyporhamphus tricuspidatus* Gill = *Hemirhamphus unifasciatus* Ranzani)

35. Hemirhamphus fasciatus Poey
= Hyporhamphus unifasciatus (Ranzani)

Hemirhamphus fasciatus Poey, 1860:299; 1861:377; 1867:167.
Hemirhamphus poeyi, Poey, 1868:383; 1876:121.
Hemirhamphus unifasciatus Ranzani, 1842:326.
Hyporhamphus unifasciatus, Jordan & Evermann, 1896:720.

Cotypes: M. C. Z. 32934, 2 specimens. No. Poey 194.
Type locality: Habana Bay.

Hemiramphus

Hemiramphus Cuvier, 1817:186 (*Esox brasiliensis* Linnaeus)

36. Hemirhamphus filamentosus Poey
= Hemiramphus brasiliensis (Linnaeus)

Hemirhamphus filamentosus Poey, 1860:297; 1861:377. 1868:382; 1876:121.
Esox brasiliensis Linnaeus, 1758:314.
Hemiramphus brasiliensis, Jordan & Evermann, 1896:722.

Types: M. C. Z. 8775, the largest being the holotype, the other two paratypes, 290 & 320 mm. No. Poey 50.

BOTHIDAE

Bothus

Bothus Rafinesque, 1810a:23 (*Bothus rumulo* Rafinesque)

37. Rhomboidichthys spinosus Poey
=Bothus ocellatus (Agassiz)
Rhomboidichthys spinosus Poey, 1868:409; 1876:139.
Platophrys spinosus, Jordan & Evermann, 1898:2662.
Rhombus ocellatus Agassiz, 1831:85, pl. 46.
Bothus ocellatus, Norman, 1934:222.
Holotype: M. C. Z. 11345. No. Poey 669.

Syacium

Syacium Ranzani, 1840:20 (*Syacium micrurum* Ranzani)

38. Hippoglossus ocellatus Poey
=Syacium micrurum Ranzani
Hippoglossus ocellatus Poey, 1861:314, 385.
Hemirhombus ocellatus, Poey, 1868:407; 1876:138.
Syacium micrurum Ranzani, 1840:20, pl. 5; Jordan & Evermann, 1898:2672; Norman, 1934:132.
Holotype: M. C. Z. 11188. Paratypes: M. C. Z. 11144, 11192, 11194. No. Poey 515.

Citharichthys

Citharichthys Bleeker, 1862a:427 (*Citharichthys cayennensis* Bleeker = *Citharichthys spilopterus* Günther)

39. Hemirhombus fuscus Poey
=Citharichthys spilopterus Günther
Hemirhombus fuscus Poey, 1868:406; 1876:138.
Citharichthys spilopterus Günther, 1862:421; Jordan & Evermann, 1898:2685; Norman, 1934:149.
Cotypes: M. C. Z. 11251. No. Poey 227.

POLYMIXIIDAE

Polymixia

Polymixia Lowe, 1838:198 (*Polymixia nobilis* Lowe)

40. Dinemus venustus Poey
=Polymixia lowei Günther.
Dinemus venustus Poey, 1860:161, pl. 14, fig. 1; 1861:366.
Polymixia lowei Günther, 1859:17; Poey, 1868:297; 1875:35; Jordan & Evermann, 1896:854.
Cotypes: M. C. Z. 21812, 2 specimens 165 & 250 mm. No. Poey 160.

HOLOCENTRIDAE

Ostichthys

Ostichthys Jordan & Evermann, 1896:846 (*Myripristis japonicus* Cuvier & Valenciennes)

41. Myriopristis fulgens Poey
=Ostichthys trachypomus (Günther)
Myriopristis fulgens Poey, 1860:160; 1861:366.
Myriopristis trachypoma Günther, 1859:25; Poey, 1868:301; 1875:38; Jordan & Evermann, 1896:-846.

Cotypes: M. C. Z. 21910, 2 specimens, 180 & 190 mm. total length, No. Poey 296.

Myripristis

Myripristis Cuvier, 1829:150 (*Myripristis jacobus* Cuvier & Valenciennes)

42. Myriopristis lychnus Poey
=Myripristis jacobus Cuvier & Valenciennes
Myriopristis lychnus Poey, 1860:159; 1861:366; 1868:301; 1875b:38.
Myripristis jacobus Cuvier & Valenciennes, 1829a:121; Poey, 1865:274; Jordan & Evermann, 1896:846.

Types: M. C. Z. 10982, 8 specimens, the holotype 206 mm., the paratype 150 mm. long. No. Poey 204.

Holocentrus

Holocentrus Bloch, 1790:61 (*Holocentrus sogo* Bloch)

43. Holocentrus matejuelo Poey
=Holocentrus ascensionis (Osbeck)
Holocentrus matejuelo Poey (not of Bloch and Schneider), 1860:155, pl. 13, fig. 13–14; 1861:366; 1868:298; 1875b:35.
Perca ascensionis Osbeck, 1765:388.
Holocentrum longipinne, Poey, 1865:274.
Holocentrus ascensionis, Jordan & Evermann, 1896: 848.

Cotypes: M. C. Z. 21915–18; specimens 220 to 260 mm. No. Poey 26.

44. Holocentrum vexillarium Poey
=Holocentrus vexillarius (Poey)

Holocentrum vexillarium Poey, 1860:158; 1861:366; 1868:299; 1875b:37.
Holocentrus vexillarius, Jordan & Evermann, 1896:852.

Holotype: M. C. Z. 10935. No. Poey 303.

45. HOLOCENTRUM RIPARIUM Poey
=HOLOCENTRUS VEXILLARIUS (Poey)
Holocentrum riparium Poey, 1875b:37.
Holocentrus vexillarius, Jordan & Evermann, 1896:852.

Types: M. C. Z. 10934, the holotype being the largest of the four specimens. Paratypes: M. C. Z. 10936, 15 specimens, 43.5 to 60 mm. No. Poey 542.

46. HOLOCENTRUM PERLATUM Poey
=HOLOCENTRUS OSCULUS (Poey)
Holocentrum perlatum Poey, 1860:157; 1861:366; 1868:298; 1875b:36.
Holocentrum osculum, Poey, 1860:156.
Holocentrus osculus, Jordan & Evermann, 1896:853.

Holotype: M. C. Z. 10938. No. Poey 535.

FLAMMEO

Flammeo Jordan & Evermann, 1898:2871 (*Holocentrum marianus* Cuvier & Valenciennes)

47. HOLOCENTRUM ROSTRATUM Poey
=FLAMMEO MARIANUS (Cuvier & Valenciennes)
Holocentrum rostratum Poey, 1860:157; 1861:366; 1868:298; 1875b:38.
Holocentrum marianus Cuvier & Valenciennes, 1829a: 164.
Holocentrus marianus, Jordan & Evermann, 1896:852.
Flammeo marianus, Jordan & Evermann, 1898:2871.

Cotypes: M. C. Z. 10969, 2 specimens 143 & 150 mm. total length. No. Poey 446.

PLECTRYPOPS

Plectrypops Gill, 1862b:237 (*Holocentrum retrospinis* Guichenot)

48. HOLOCENTRUM PROSPINOSUM Poey
=PLECTRYPOPS RETROSPINIS (Guichenot)
Holocentrum prospinosum Poey, 1861:343.
Myriopristis prospinosum, Poey, 1861:366.

Plectrypops prospinosus, Poey, 1868:302; 1875b:38.
Holocentrum retrospinis Guichenot, 1853:35; pl. 1, fig. 3.
Plectrypops retrospinis, Jordan & Evermann, 1896: 853.

Lectotype: M. C. Z. 21884. No. Poey 534. Species first described based on Guichenot's figure.

SYNGNATHIDAE

Syngnathus

Syngnathus Linnaeus, 1758:336 (*Syngnathus acus* Linnaeus)

49. Syngnathus brachycephalus Poey

Syngnathus brachycephalus Poey, 1868:444; 1876:375.
Siphostoma brachycephalum, Jordan & Evermann, 1896:769.

Types: M. C. Z. 11726; the male Holotype, the female Paratype. No. Poey 685.

ATHERINIDAE

Hepsetia

Hepsetia Bonaparte, 1837 (no pages) (*Atherina boyeri* Risso)

50. Atherina laticeps Poey
=Hepsetia stipes (Müller & Troschel)

Atherina laticeps Poey, 1860:265; 1861:380; 1868:390; 1876:100; Jordan & Evermann, 1896:790.
Atherina stipes Müller & Troschel, 1847:671; Jordan & Evermann, 1896:790.
Hepsetia stipes, Jordan & Hubbs, 1919:34.

Holotype: M. C. Z. 18227. Paratypes: M. C. Z. 18228, 17 specimens 50 to 68 mm.; M. C. Z. 18229, 4 specimens, 49 to 75 mm.; M. C. Z. 18230, 6 specimens, 65 to 80 mm. No. Poey 582.

MUGILIDAE

Mugil

Mugil Artedi, in Linnaeus, 1758:316 (*Mugil cephalus* Linnaeus)

51. Mugil lebranchus Poey
=Mugil brasiliensis Agassiz.

Mugil lebranchus Poey, 1860:260, pl. 18, fig. 3; 1861:379; 1868:388; 1876:98.

Mugil brasiliensis Agassiz, 1829:134, pl. 72; Jordan & Evermann, 1897:810.

Cotypes: M. C. Z. 34160–61. Complete unmounted skeletons of two specimens, about 540 and 640 mm. long. No. Poey 193.

Type locality: Cienfuegos, Sta. Clara Prov.

Joturus

Joturus Poey, 1860:263 (*Joturus pichardi* Poey)

52. Joturus pichardi Poey

Joturus pichardi Poey, 1860:263, pl. 18, fig. 4–5; 1861:380; 1868:390; 1876:99; Jordan & Evermann, 1896:821.

Holotype: M. C. Z. 23886. No. Poey 518.

Type locality: Rio Almendares, near Habana.

SPHYRAENIDAE

Sphyraena

Sphyraena Röse, in Artedi, 1793:52 (*Esox sphyraena* Linnaeus)

53. Sphyraena picudilla Poey

Sphyraena picudilla Poey, 1860:162; 1861:372; 1868:359; 1876: 96; Jordan & Evermann, 1896–824.

Cotype: M. C. Z. 25967, specimen 365 mm. long. No. Poey 361.

GEMPYLIDAE

Gempylus

Gempylus Cuvier & Valenciennes, 1831b:152 (*Gempylus serpens* Cuvier & Valenciennes)

54. Gempylus ophidianus Poey

=Gempylus serpens Cuvier & Valenciennes

Gempylus ophidianus Poey, 1860:246, pl. 18, fig. 1; 1861:373.

Prometheus ofidianus, Poey, 1868:364.

Nealotus ophidianus, Poey, 1876:94.

Gempylus serpens Cuvier & Valenciennes, 1831b:152; Jordan & Evermann, 1896:884.

Holotype: M. C. Z. 8586. No. Poey 408.

NOMEIDAE

Nomeus

Nomeus Cuvier, 1817:315 (*Gobius gronovii* Gmelin)

55. Nemeus oxyurus Poey
=Nomeus gronovii (Gmelin)
Nomeus oxyurus Poey, 1860;236; 1868:376; 1876:91.
Gobius gronovii Gmelin, 1788:1205.
Nomeus gronovii, Jordan & Evermann, 1896:949.

Types: M. C. Z. 16963, two specimens, the largest of which is the Holotype. No. Poey 492.
Type locality: Habana.

CARANGIDAE

Hemicaranx

Hemicaranx Bleeker, 1862b:135 (*Hemicaranx marginatus* Bleeker)

56. Caranx heteropygus Poey
=Hemicaranx amblyrhynchus (Cuvier & Valenciennes)
Caranx heteropygus Poey, 1861:344, 373; 1867:164; 1875b:77.
Caranx amblyrhynchus Cuvier & Valenciennes, 1833:76, pl. 248; Poey, 1866a:328.
Carangops amblyrhynchus, Poey, 1868:366.
Hemicaranx amblyrhynchus, Jordan & Evermann, 1896:912.

Holotype: M. C. Z. 17254. No. Poey 605.
Type locality: Habana.

Elaphotoxon

Elaphotoxon Fowler, 1905:76 (*Scomber ruber* Bloch)

57. Caranx cibi Poey
=Elaphotoxon bartholomaei (Cuvier & Valenciennes)
Caranx eibi Poey, 1860:224.
Carangoides eibi, Poey, 1866b:15; 1868:366; 1875b:76.
Caranx bartholomaei Cuvier & Valenciennes, 1833:75; Jordan & Evermann, 1896:919.

Holotype: M. C. Z. 17252. No. Poey 540.

Xurel

Xurel Jordan & Evermann, 1927:505 (*Caranx vinctus* Jordan & Gilbert)

58. Caranx secundus Poey
=Xurel fasciatus (Cuvier & Valenciennes)
Caranx secundus Poey, 1860:223; 1861:373.
Carangops secundus Poey, 1866b:15; 1868:367; 1875b: 78.
Caranx fasciatus Cuvier & Valenciennes, 1833:53.
Hemicaranx secundus, Jordan & Evermann, 1896:914.

Cotypes: M. C. Z. 16702–03, two specimens 335 and 385 mm. total length. No. Poey 186.

59. Caranx frontalis Poey
=Xurel lugubris (Poey)
Caranx frontalis Poey, 1860:222; 1861:373.
Caranx lugubris Poey, 1860:222; 1861:373; Jordan & Evermann, 1896:924.
Carangus lugubris, Poey, 1868:365; 1875b:76.

Cotype: M. C. Z. 17348, specimen 470 mm. long. No. Poey 552.

Hynnis

Hynnis Cuvier & Valenciennes, 1833:145 pl. 257 (*Hynnis goreensis* Cuvier & Valenciennes)

60. Hynnis cubensis Poey
Hynnis cubensis Poey, 1860:235; 1861:374; 1868:368; 1875b:79; Jordan & Evermann, 1896:932.

Type: M. C. Z. 34155, a complete unmounted skeleton, which, judging by its size and that of the specimen described (770 mm.), might be the holotype. No. Poey 457.

SERIOLIDAE

Elagatis

Elagatis Bennett, 1840:283 (*Seriola bipinnulata* Quoy & Gaimard)

61. Seriola pinnulata Poey
=Elagatis bipinnulatus (Quoy & Gaimard)
Seriola pinnulata Poey, 1860:233.
Decapterus pinnulatus, Poey, 1861:374.
Elagatis pinnulatus, Poey, 1868:373.

Seriola bipinnulata Quoy & Gaimard, 1824:363, pl. 61, fig. 3.

Elagatis bipinnulatus, Poey, 1875b:83; Jordan & Evermann, 1896:906.

Cotypes: M. C. Z. 17228, 1 specimen 315 mm. long. No. Poey 349.

APOGONIDAE

Apogon

Apogon Lacépède, 1802:411 (*Apogon ruber* Lacépède = *Mullus imberbis* Linnaeus)

62. Monoprion maculatus Poey
= Apogon maculatus (Poey)

Monoprion maculatus Poey, 1860:123; 1861:362; 1875b:34.

Amia maculata, Poey, 1867:235; 1868:304.

Apogon maculatus, Jordan & Evermann, 1896:1109.

Holotype: M. C. Z. 9745. Paratype: M. C. Z. 9755. No. Poey 436.

63. Monoprion pigmentarius Poey
= Apogon pigmentarius (Poey)

Monoprion pigmentarius Poey, 1860:123; 1861:362; 1875b:35.

Amia pigmentaria, Poey, 1867:235; 1868:305.

Apogon pigmentarius, Jordan & Evermann, 1896:1109.

Type: M. C. Z. 9753, probably the holotype, specimen very much dried up, with tip of tail broken. No. Poey 270.

64. Amia binotata Poey
= Apogon binotatus (Poey)

Amia binotata Poey, 1867:234; 1868:305.

Monoprion binotatus, Poey, 1875b:35.

Apogon binotatus, Jordan & Evermann, 1896:1109.

Cotypes: M. C. Z. 9750, 3 specimens 48.5 to 52.5 mm. No. Poey 660.

Apogonichthys

Apogonichthys Bleeker, 1854:321 (*Apogonichthys perdix* Bleeker)

65. Apogonichthys puncticulatus Poey

Apogonichthys puncticulatus Poey, 1867:233; 1868:305; 1875b:35; Jordan & Evermann, 1896:1111.

Holotype: M. C. Z. 9695. No. Poey 643.

CENTROPOMIDAE

Centropomus

Centropomus Lacépède, 1803a:248 (*Sciaena undecimalis* Bloch)

66. Centropomus appendiculatus Poey
= Centropomus undecimalis (Bloch)
Centropomus appendiculatus Poey, 1860:119, pl. 13, fig. 1; 1861:362; 1868:280; 1875b:32.
Sciaena undecimalis Bloch, 1792:60;
Centropomus undecimalis, Poey, 1865:194; Jordan & Evermann, 1896:1119.

Cotypes: M. C. Z. 10274, specimen 230 mm. long; 10306, specimen 330 mm. long, and 34156, unmounted complete skeleton, about 540 mm. long. No. Poey 51.

67. Centropomus pedimacula Poey
Centropomus pedimacula Poey, 1860:122, pl. 13, fig. 4–5; 1861:362; 1868:280; 1875b:33; Jordan & Evermann, 1896:1119.

Holotype: M. C. Z. 10273. Paratype: M. C. Z. 10272. No. Poey 560.
Type locality: Cienfuegos, Sta. Clara Prov.

68. Centropomus parallelus Poey
Centropomus parallelus Poey, 1860:120, pl. 13, fig. 2–3; 1861:362; 1868:280; 1875b:33; Jordan & Evermann, 1896:1122.

Holotype: M. C. Z. 10271. No. Poey 134.
Type locality: Cienfuegos, Sta. Clara Prov.

69. Centropomus ensiferus Poey
Centropomus ensiferus Poey, 1860:122, pl. 12, fig. 1; 1861:362; 1868:280; 1875b:33; Jordan & Evermann, 1896:1125.

Cotypes: M. C. Z. 10299 and 10300, two specimens 260 and 310 mm. No. Poey 561.

EPINEPHELIDAE

Petrometopon

Petrometopon Gill, 1865:105 (*Perca guttatus* Poey = *Sparus cruentatus* Lacépède)

70. Serranus apiarius Poey
= Petrometopon cruentatus (Lacépède)

Serranus apiarius Poey, 1860:143; 1861:364.
Petrometopon apiarius, Poey, 1868:288; 1875b:20.
Sparus cruentatus Lacépède, 1802:156.
Petrometopon cruentatus, Jordan & Evermann, 1896: 1141.

Holotype: M. C. Z. 10158. No. Poey 210.

Menephorus

Menephorus Poey, 1871:50 (*Serranus dubius* Poey)

71. Menephorus punctiferus Poey
Menephorus punctiferus Poey, 1875b:21.
Bodianus punctiferus, Jordan & Evermann, 1896:1147.

Holotype: M. C. Z. 10019. No. Poey 309.

Epinephelus

Epinephelus Bloch, 1793:11 (*Epinephelus marginalis*)

72. Serranus mystacinus Poey
= Epinephelus mystacinus (Poey)
Serranus mystacinus Poey, 1852:52, pl. 10, fig. 1; 1861:364; 1867:154.
Schistorus mystacinus Poey, 1868:287; 1875b:18.
Epinephelus mystacinus, Jordan & Evermann, 1896: 1151.

Holotype: M. C. Z. 9991. No. Poey 39.

73. Serranus conspersus Poey
= Epinephelus niveatus (Cuvier & Valenciennes)
Serranus conspersus Poey, 1860:139; 1861:364; 1867: 157.
Serranus niveatus Cuvier & Valenciennes, 1828:285.
Epinephelus niveatus, Poey, 1868:286; 1875b:15; Jordan & Evermann, 1896:1156.

Cotypes: M. C. Z. 10161, three specimens, 112 to 180 mm. No. Poey 503.

Promicrops

Promicrops Gill, in Poey, 1868:287 (*Serranus guasa* Poey = *itaiara* Lichtenstein)

74. Serranus guasa Poey
= Promicrops itaiara (Lichtenstein)

Serranus guasa Poey, 1860:141, pl. 13, fig. 8; 1861:354, 363; 1867:154.
Promicrops guasa Poey, 1868:287; 1875b:13.
Serranus itaiara Lichtenstein, 1821:278.
Promicrops guttatus, Jordan & Evermann, 1898:1162.

Type: M. C. Z. 34157, complete unmounted skeleton of paratype, specimen mentioned in Memorias, 1861:354 (720 mm.); besides there is a skull measuring 335 mm. No. Poey 138.

Trisotropis

Trisotropis Gill, 1865:104 (*Johnius guttatus* Bloch & Schneider = *Perca venenosa* Linnaeus)

75. Serranus bonaci Poey
= Trisotropis bonaci (Poey)
Serranus bonaci Poey, 1860:129; 1861:363; 1867:155.
Trisotropis bonaci Poey, 1868:283; 1870a:306; 1875b: 13.
Mycteroperca bonaci, Jordan & Evermann, 1896:1174.

Cotypes: M. C. Z. 10000 (2 spec.), 10032–34, 10195; 6 specimens, 98 to 358 mm. No. Poey 388.

76. Serranus brunneus Poey
= Trisotropis bonaci (Poey)
Serranus brunneus Poey, 1860:131; 1861:363; 1867: 156.
Trisotropis brunneus Poey, 1868:282; 1870a:305; 1875b:13.
Serranus bonaci Poey, 1860:121.
Mycteroperca bonaci, Jordan & Evermann, 1896:1174.

Types: M. C. Z. 10184, 2 specimens, the largest of which is the holotype. No. Poey 208.

77. Serranus cyclopomatus Poey
= Trisotropis bonaci (Poey)
Serranus cyclopomatus Poey, 1861:353, 363; 1867:156.
Trisotropis cyclopomatus Poey, 1868:284.
Trisotropis brunneus Poey, 1870a:305; 1875b:13.
Serranus bonaci Poey, 1860:121.
Mycteroperca bonaci, Jordan & Evermann, 1896:1174.

Types: M. C. Z. 10180, 2 specimens, the largest the holotype, the other a paratype. No. Poey 517.

78. SERRANUS DIMIDIATUS Poey
=TRISOTROPIS DIMIDIATUS (Poey)
Serranus dimidiatus Poey, 1860:129; 1861:363.
Trisotropis dimidiatus, Poey, 1868:285; 1870a:308; 1875b:14.
Mycteroperca dimidiata, Jordan & Evermann, 1896: 1179.
Holotype: M. C. Z. 26953. No. Poey, 350.

MYCTEROPERCA

Mycteroperca Gill, 1862b:236 (*Serranus olfax* Jenyns)

79. SERRANUS FALCATUS Poey
=MYCTEROPERCA FALCATA (Poey)
Serranus falcatus Poey, 1860:138; 1861:363.
Trisotropis falcatus Poey, 1868:285; 1870a:309; 1875b: 15; Jordan & Evermann, 1896:1184.
Cotypes: M. C. Z. 10188, 10014, 10183, three specimens 270 to 405 mm.; M. C. Z. 34158, complete unmounted skeleton, about 630 mm. long. No. Poey 43.

80. MYCTEROPERCA CALLIURA Poey
Mycteroperca calliura Poey, 1865:181; 1866a:409.
Trisotropis calliurus Poey, 1868:284; 1870a:309; 1875b:14.
Mycteroperca calliura, Jordan & Evermann, 1896: 1186.
Cotype: M. C. Z. 10011, specimen 320 mm. long. No. Poey 65.

81. SERRANUS FELINUS Poey
=MYCTEROPERCA TIGRIS (Cuvier & Valenciennes)
Serranus felinus Poey, 1860:134; 1861:363; 1867:155.
Trisotropis felinus Poey, 1868:283; 1870a:307.
Serranus tigris Cuvier & Valenciennes, 1833:325.
Trisotropis tigris, Poey, 1875b:14.
Mycteroperca tigris, Jordan & Evermann, 1896:1187.
Holotype: M. C. Z. 10071. No. Poey 576.

82. SERRANUS REPANDUS Poey
=MYCTEROPERCA TIGRIS (Cuvier & Valenciennes)
Serranus repandus Poey, 1860:135; 1861:363; 1867: 155
Trisotropis felinus, Poey, 1868:283.

Serranus tigris Cuvier & Valenciennes, 1833:325.
Trisotropis tigris, Poey, 1875b:14.
Mycteroperca tigris, Jordan & Evermann, 1896:1187.

Holotype: M. C. Z. 10076. No. Poey 568.

Chorististium

Chorististium Gill, 1862a:15 (*Liopropoma rubre* Poey)

83. Liopropoma rubre Poey
=Chorististium rubrum (Poey)
Liopropoma rubre Poey, 1861:418.
Chorististium rubrum, Poey, 1868:291; 1875b:32; Jordan & Evermann, 1896:1136.

Holotype: M. C. Z. 9691. No. Poey 417.

SERRANIDAE

Prionodes

Prionodes Jenyns, 1842:46 (*Prionodes fasciatus* Jenyns)

84. Centropristes fusculus Poey
=Prionodes fusculus (Poey)
Centropristes fusculus Poey, 1861:342, 365.
Haliperca fusculus, Poey, 1868:281; 1875b:22.
Prionodes fusculus, Jordan & Evermann, 1896:1211.

Holotype: M. C. Z. 10015. No Poey 300

85. Serranus phoebe Poey
=Prionodes phoebe (Poey)
Serranus phoebe Poey, 1852:55, pl. 2, fig. 3.
Centropristes phoebe, Poey, 1861:365.
Haliperca phoebe, Poey, 1868:281; 1875b:22.
Prionodes phoebe, Jordan & Evermann, 1896:1211.

Cotypes: M. C. Z. 36949, 200 mm. total length; 31437, 163 mm. total length. No. Poey 322.

86. Serranus jacome Poey
=Prionodes tabacaria (Cuvier & Valenciennes)
Serranus jacome Poey, 1852:57, pl. 2, fig. 1.
Haliperca jacome, Poey, 1875b:22.
Centropristes tabacarius Cuvier & Valenciennes, 1829a:33; Poey, 1861:365.
Haliperca tabacaria, Poey, 1868:282.
Prionodes tabacarius, Jordan & Evermann, 1896:1215.

Cotypes: M. C. Z. 10008, 10067, two specimens 145 mm. long No. Poey 216.

87. SERRANUS PRAESTIGIATOR Poey
= PRIONODES TIGRINUS (Bloch)
Serranus praestigiator Poey, 1852:58, pl. 2, fig. 2.
Haliperca praestigiator, Poey, 1868:282; 1875b:22.
Holocentrus tigrinus Bloch, 1790:77.
Serranus tigrinus, Poey, 1861:363.
Prionodes tigrinus, Jordan & Evermann, 1896:1214.
Holotype: M. C. Z. 10241. No. Poey 324.

HYPOPLECTRUS

Hypoplectrus Gill, 1862b:236 (*Plectropoma puella* Cuvier & Valenciennes = variety of *Perca unicolor* Walbaum)

88. HYPOPLECTRUS MACULIFERUS Poey
= HYPOPLECTRUS UNICOLOR (Walbaum)
Hypoplectrus maculiferus Poey, 1871:78, pl. 1, fig. 2; 1875b:24.
Perca unicolor Walbaum, 1792:352.
Hypoplectrus unicolor, Jordan & Evermann, 1896:1192
Holotype: M. C. Z. 9783, specimen 120 mm. long. No. Poey 390.

89. HYPOPLECTRUS PINNIVARIA Poey
= HYPOPLECTRUS UNICOLOR PINNIVARIUS (Poey)
Hypoplectrus pinnivaria Poey, 1868:291; 1875b:24.
Hypoplectrus unicolor pinnivarius, Jordan & Evermann, 1896:1192.
Holotype: M. C. Z. 34035. No. Poey 642.

90. PLECTROPOMA GUTTAVARIUM Poey
= HYPOPLECTRUS UNICOLOR GUTTAVARIUS (Poey)
Plectropoma guttavarius Poey, 1852:70; 1854:441; 1861:364.
Hypoplectrus guttavarius, Poey, 1868:291; 1875b:24,
Hypoplectrus unicolor pinnivarius, Jordan & Evermann, 1896:1192.
Cotypes: M. C. Z. 9781, two specimens 123 & 130 mm. long. No. Poey 323.

91. PLECTROPOMA NIGRICANS Poey
= HYPOPLECTRUS UNICOLOR NIGRICANS (Poey)

Plectropoma nigricans Poey, 1852:71; 1861:364.
Hypoplectrus nigricans, Poey, 1868:290; 1875b:24.
Hypoplectrus unicolor nigricans, Jordan & Evermann, 1896:1193.

Holotype: M. C. Z. 34036. No. Poey 430.

92. Plectropoma bovinum Poey
=Hypoplectrus unicolor bovinum (Poey)

Plectropoma bovinum Poey, 1852:69; 1861:364.
Hypoplectrus bovinus, Poey, 1868:290; 1875b:23.
Hypoplectrus unicolor bovinum, Jordan & Evermann, 1896:1193.

Cotypes: M. C. Z. 9795, two specimens 125 & 132 mm. long. No. Poey 129.

PRIACANTHIDAE

Priacanthus

Priacanthus Cuvier, 1817:281 (*Priacanthus macrophthalmus* Cuvier)

93. Priacanthus catalufa Poey
=Priacanthus arenatus Cuvier & Valenciennes

Priacanthus catalufa Poey, 1863:182; 1865:274; 1868:302; 1875b:38.
Priacanthus arenatus Cuvier & Valenciennes, 1829:75; Poey, 1865:274; Jordan & Evermann, 1896:1237.

Types: M. C. Z. 9766, three specimens, the one bearing Poey's original number label being the holotype. No. Poey 637.

PEMPHERIDAE

Pempheris

Pempheris Cuvier, 1829:195 (*Kurtus argenteus* Bloch & Schneider = *Pempheris touea* Cuvier

94. Pempheris mülleri Poey

Pempheris mülleri Poey, 1860:203; 1861:371; 1868:358; 1876:94; Jordan & Evermann, 1896:978.

Types: M. C. Z. 17318, two specimens, the larger of which is the holotype. No. Poey 415.

LUTIANIDAE

Lutianus

Lutianus Bloch, 1790:105 (*Lutianus lutianus* Bloch)

95. Mesoprion caudanotatus Poey
=Lutianus buccanella (Cuvier & Valenciennes)
Mesoprion caudanotatus Poey, 1854:440, pl. 3, fig. 3; 1861:365; 1867;158.
Mesoprion buccanella Cuvier & Valenciennes, 1828: 344; Poey, 1868:295.
Lutjanus buccanella, Poey, 1875b:27.
Neomenis buccanella, Jordan & Evermann, 1898:1261.
Cotypes: M. C. Z. 9804; 9823, 9870, 9932, 9888, from 150 to 260 mm. No. Poey 217.

96. Mesoprion profundus Poey
=Lutianus vivanus (Cuvier & Valenciennes)
Mesoprion profundus Poey, 1860:150; 1861:365; 1865: 267; 1867:157; 1868:294.
Lutjanus profundus, Poey, 1875b:28.
Mesoprion vivanus Cuvier & Valenciennes, 1828:343.
Neomenis vivanus, Jordan & Evermann, 1898:1262.
Cotypes: 9966, 9990, two specimens 340 & 415 mm. long. No. Poey 28.

97. Mesoprion campechanus Poey
=Lutianus campechanus (Poey)
Mesoprion campechanus Poey, 1860:149; 1861:365; 1868:294; 1875b:29.
Neomenis aya, Jordan & Evermann, 1898:1264.
Types: M. C. Z. 9982, two specimens the largest of which is the holotype. No. Poey 71.

98. Mesoprion ambiguus Poey
=Lutianus ambiguus (Poey)
Mesoprion ambiguus Poey, 1860:152, pl. 12, fig. 4, pl. 13, fig. 18; 1861:365.
Ocyurus ambiguus, Poey, 1868:295.
Lutjanus ambiguus, Poey, 1875b:30.
Neomenis ambiguus, Jordan & Evermann, 1898:1272.
Holotype: M. C. Z. 9951. No. Poey 151.

99. MESOPRION OJANCO Poey

=LUTIANUS MAHOGONI (Cuvier & Valenciennes)

Mesoprion ojanco Poey, 1860: 150, pl. 13, fig. 10; 1861: 365; 1868:295.

Lutjanus ojanco, Poey, 1875b:28.

Mesoprion mahogoni Cuvier & Valenciennes, 1828:338.

Neomenis mahogoni, Jordan & Evermann, 1898:1272.

Cotypes: M. C. Z. 9917, 9939, 9950, 9952, 8 specimens 220 to 320 mm. No. Poey 86.

RHOMBOPLITES

Rhomboplites Gill, 1862b:237 (*Centropristis aurorubens* Cuvier & Valenciennes)

100. MESOPRION ELEGANS Poey

=RHOMBOPLITES AURORUBENS (Cuvier & Valenciennes)

Mesoprion elegans Poey, 1860:153; 1861:365; 1867: 158.

Rhomboplites elegans, Poey, 1868:295; 1875b:31.

Centropristis aurorubens Cuvier & Valenciennes, 1829a: 34.

Rhomboplites aurorubens, Jordan & Evermann, 1898: 1277.

Cotypes: M. C. Z. 22138, 3 specimens 290 to 330 mm. No. Poey 273.

TROPIDINIUS

Tropidinius Gill, 1868:296 (*Mesoprion arnillo* Poey = *Apsilus dentatus* Guichenot)

101. MESOPRION ARNILLO Poey

=TROPIDINIUS DENTATUS (Guichenot)

Mesoprion arnillo Poey, 1860:154; 1861:365.

Tropidinius arnillo, Poey, 1868:296; 1875b:30.

Apsilus dentatus Guichenot, 1853:29, pl. 1 fig. 2; Jordan & Evermann, 1898:1278.

Types: M. C. Z. 9954, 2 specimens, the largest of which is the holotype. No. Poey, 142.

PRISTIPOMOIDES

Pristipomoides Bleeker, 1852:574 (*Pristipomoides typus* Bleeker)

102. MESOPRION VORAX Poey

=PRISTIPOMOIDES MACROPHTHALMUS (Müller & Troschel)

Mesoprion vorax Poey, 1860:151; 1861:365.
Platyinius vorax, Poey, 1868:292; 1875b:31.
Centropristis macrophthalmus Müller & Troschel, 1848:666.
Aprion macrophthalmus, Jordan & Evermann, 1898: 1280.

Holotype: M. C. Z. 26479. No. Poey 472.

VERILIDAE

Verilus

Verilus Poey, 1860:124 (*Verilus sordidus* Poey)

103. Verilus sordidus Poey
Verilus sordidus Poey, 1860:125, pl. 12, fig. 6; 1861: 362; 1868:291; 1875b:32; Jordan & Evermann, 1898:1284.

Holotype: M. C. Z. 21764. No. Poey 141.

HAEMULIDAE

Haemulon

Haemulon Cuvier, 1829:175 (*Haemulon elegans* Cuvier = *Sparus sciurus* Shaw)

104. Haemulon notatum Poey
= Haemulon bonariensis Cuvier & Valenciennes
Haemulon notatum Poey, 1860:179; 1861:369; 1868: 317; 1875b:46.
Haemulon bonariensis Cuvier & Valenciennes, 1830a: 174; Jordan & Evermann, 1898:1297.

Cotype: M. C. Z. 10472, 288 mm. long. No. Poey 348.

105. Haemulon carbonarium Poey
Haemulon carbonarium Poey, 1860;176; 1861:369; 1868:318; 1875b:44; Jordan & Evermann, 1898: 1300.

Cotypes: M. C. Z. 10502, 3 specimens, 255 to 280 mm. No. Poey 367.

106. Haemulon dorsale Poey
= Haemulon melanurum (Linnaeus)

Haemulon dorsale Poey, 1860:179; 1861:369; 1868: 318; 1875b:44.
Perca melanura Linnaeus, 1758:292.
Haemulon melanurum, Jordan & Evermann, 1898: 1302.

Cotype: M. C. Z. 10590, 205 mm. long. No. Poey 364.

107. Haemulon luteum Poey
=Haemulon sciurus (Shaw)
Haemulon luteum Poey, 1860:174; 1861:354; 369; 1868:317; 1875b:44.
Sparus sciurus Shaw, 1803:439, pl. 64.
Haemulon sciurus, Jordan & Evermann, 1898:1303.

Cotype: M. C. Z. 1078a, 192 mm. long. No. Poey 511.

108. Haemulon multilineatum Poey
=Haemulon sciurus (Shaw)
Haemulon multilineatum Poey, 1860:178; 1861:369; 1868:318; 1875b:44.
Sparus sciurus Shaw, 1803:439, pl. 64.
Haemulon sciurus, Jordan & Evermann, 1898:1303.

Holotype: M. C. Z. 10478. No. Poey 376.

109. Haemulon arara Poey
=Haemulon plumieri (Lacépède)
Haemulon arara Poey, 1860:177; 1861:369; 1868:318; 1875b:45.
Labrus plumieri Lacépède, 1802:480, pl. 2, fig. 2.
Haemulon plumieri, Jordan & Evermann, 1898:1304.

Holotype: M. C. Z. 10545, specimens very much dried up. No. Poey 291.

Brachygenys

Brachygenys Scudder, in Poey, 1875b:47 (*Haemulon taeniatum* Poey = *Haemulon chrysargyreum* Günther)

110. Haemulon taeniatum Poey
=Brachygenys chrysargyreus (Günther)
Haemulon taeniatum Poey, 1860: 182; 1861:369; 1868: 319.
Brachygenys taeniata, Poey, 1875b:47.
Haemulon chrysargyreus Günther, 1859:314.
Brachygenys chrysargyreus, Jordan & Evermann, 1898: 1307.

Types: M. C. Z. 10482, 3 specimens, the largest of which is the holotype. No. Poey 369.

Bathystoma

Bathystoma Scudder in Putnam, 1863:12 (*Haemulon jeniguano* Poey = *Haemulon aurolineatum* Cuvier & Valenciennes)

111. Haemulon jeniguano Poey
= Bathystoma aurolineatum (Cuvier & Valenciennes)
Haemulon jeniguano Poey, 1860:183; 1861:369; 1868: 319; 1875b:47.
Haemulon aurolineatum Cuvier & Valenciennes, 1830a: 176.
Bathystoma aurolineatum, Jordan & Evermann, 1898:1310.
Holotype: M. C. Z. 1080. No. Poey 420.

112. Haemulon quinquelineatum Poey
= Bathystoma striatum (Linnaeus)
Haemulon quinquelineatum Poey, 1861:419; 1867:161.
Haemulon quadralineatum Poey, 1868:319; 1875b:47.
Perca striata Linnaeus, 1758:293.
Bathystoma striatum, Jordan & Evermann, 1898:1310.
Holotype: M. C. Z. 10542. No. Poey 211.

Anisotremus

Anisotremus Gill, 1861:105 (*Sparus virginicus* Linnaeus)

113. Haemulon obtusum Poey
= Anisotremus surinamensis (Bloch)
Haemulon obtusum Poey, 1860:182; 1861:369.
Anisotremus obtusus, Poey, 1868:312; 1875b:43.
Lutjanus surinamensis Bloch, 1790:98.
Anisotremus surinamensis, Jordan & Evermann, 1898:1318.
Cotype: M. C. Z. 34159, complete unmounted skeleton, about 540 mm. long. No. Poey 170.

114. Pristipoma spleniatum Poey
= Anisotremus spleniatus (Poey)
Pristipoma spleniatum Poey, 1860:187.
Anisotremus spleniatus, Poey, 1861:368; 1875b:43; Jordan & Evermann, 1898:1321.
Cotype: M. C. Z. 21778, 65 mm. total length. No. Poey 49.

Pomadasys

Pomadasys Lacépède, 1803a:516 (*Sciaena argentea* Forskål)

115. Pristipoma productum Poey
=Pomadasys productus (Poey)
Pristipoma productum Poey, 1860:186; 1861:368; 1868:311; 1875b:42.
Pomadasys productus, Jordan & Evermann, 1898:1332.
Cotype: M. C. Z. 21889, 245 mm. long. No. Poey 418.

Rhonciscus

Rhonciscus Jordan & Evermann, 1895:387 (*Pristipoma crocro* Cuvier & Valenciennes)

116. Pristipoma cultriferum Poey
=Rhonciscus crocro (Cuvier & Valenciennes)
Pristipoma cultriferum Poey, 1860:185; 1861:368; 1868:310; 1875b:41.
Pristipoma crocro Cuvier & Valenciennes, 1830a:197.
Pomadasys crocro, Jordan & Evermann, 1898:1333.
Cotypes: M. C. Z. 10594, 10592; 145 and 140 mm. No. Poey 84.

SPARIDAE

CALAMUS

Calamus Swainson, 1839:171, 221 (*Pagellus calamus* Cuvier & Valenciennes)

117. Pagellus orbitarius Poey
=Calamus calamus (Cuvier & Valenciennes)
Pagellus orbitarius Poey, 1860:201; 1861:367.
Sparus orbitarius, Poey, 1868:308.
Calamus orbitarius, Poey, 1872:179, pl. 6, fig. 2; 1875b:56.
Pagellus calamus Cuvier & Valenciennes, 1830b:152, pl. 152.
Calamus calamus, Jordan & Evermann, 1898:1349.
Holotype: M. C. Z. 21849. No. Poey 149.

118. Pagellus caninus Poey
=Calamus bajonado (Bloch & Schneider)

Pagellus caninus Poey, 1860:199; 1861:367; 1867:160.
Sparus bajonado Bloch & Schneider, 1801:284; Poey, 1868:308.
Calamus bajonado, Poey, 1872:176, pl. 6, fig. 1; 1875b:55; Jordan & Evermann, 1898:1352.

Cotypes: M. C. Z. 21835, 21834, 390 and 430 mm. No. Poey 468.

119. CALAMUS MACROPS Poey
Calamus macrops Poey, 1872:181, pl. 7, fig. 3; 1875b:56; Jordan & Evermann, 1898:1354.

Holotype: M. C. Z. 21839. No. Poey 221.

120. PAGELLUS HUMILIS Poey
= CALAMUS PENNA (Cuvier & Valenciennes)
Pagellus humilis Poey, 1868:308.
Grammateus humilis, Poey, 1872:182; 1875b:56.
Pagellus penna Cuvier & Valenciennes, 1830b:154.
Calamus penna, Jordan & Evermann, 1898:1354.

Cotypes: M. C. Z. 21843–44, 195 & 185 mm. total length. No. Poey 288.

121. GRAMMATEUS MEDIUS Poey
= CALAMUS MEDIUS (Poey)
Grammateus medius Poey, 1872:183, pl. 7, fig. 4; 1875b:56.
Calamus medius, Jordan & Evermann, 1898:1356.

Paratype: M. C. Z. 21842. No. Poey 192.

SALEMA

Salema Jordan & Evermann, 1895:390 (*Perca unimaculata* Bloch)

122. SARGUS CARIBAEUS Poey
= SALEMA RHOMBOIDALIS (Linnaeus)
Sargus caribaeus Poey, 1860:197; 1861:367; 1868:309; 1875b:56.
Perca rhomboidalis Linnaeus, 1758.
Archosargus unimaculatus, Jordan & Evermann, 1898:1359.

Cotype: M. C. Z. 21713, 3 specimens 175 to 260 mm. No. Poey 571.
Type locality: Batabano.

Diplodus

Diplodus Rafinesque, 1810b:54 (*Sparus annularis* Linnaeus)

123. Sargus caudimacula Poey
=Diplodus argenteus (Cuvier & Valenciennes)
Sargus caudimacula Poey, 1860:198; 1861:367; 1868: 310; 1875b:57.
Sargus argenteus Cuvier & Valenciennes, 1830b:44.
Diplodus argenteus, Jordan & Evermann, 1898:1363.
Cotype: M. C. Z. 21715, 275 mm. long. No. Poey 589.

KYPHOSIDAE

Kyphosus

Kyphosus Lacépède, 1802:114 (*Kyphosus bigibbus* Lacépède =*fuscus* Lacépède)

124. Pimelepterus flavo-lineatus Poey
=Kyphosus incisor (Cuvier & Valenciennes)
Pimelepterus flavo-lineatus Poey, 1866a:319; 1868:324; 1875b:65.
Pimelepterus incisor Cuvier & Valenciennes, 1831a: 198; Poey, 1866a:319.
Kyphosus incisor, Jordan & Evermann, 1898:1386.
Holotype: M. C. Z. 21712. No. Poey 371.

GERRIDAE

Eugerres

Eugerres Jordan & Evermann, 1927:506 (*Gerres plumieri* Cuvier & Valenciennes)

125. Gerres patao Poey
=Eugerres brasilianus (Cuvier & Valenciennes)
Gerres patao Poey, 1860:192; 1868:320; 1875b:50.
Gerres brasilianus Cuvier & Valenciennes, 1830b:344, 458; Jordan & Evermann, 1898: 1378.
Cotype: M. C. Z. 23151, 290 mm. long. No. Poey 173.

MULLIDAE

Upeneus

Upeneus Cuvier, 1829:157 (*Upeneus bifasciatus* Lacépède)

126. Upeneus flavovittatus Poey
=Upeneus martinicus Cuvier & Valenciennes
Upeneus flavovittatus Poey, 1853:224, pl. 17, fig. 4; 1861:367.
Mulloides flavovittatus, Poey, 1868:307; 1875b:34.
Upeneus martinicus Cuvier & Valenciennes, 1829a: 356; Jordan & Evermann, 1896:859.

Holotype: M. C. Z. 21819. No. Poey 281.

SCIAENIDAE

Corvula

Corvula Jordan & Evermann, 1886:377 (*Johnius batabanus* Poey)

127. Johnius batabanus Poey
=Corvula batabana (Poey)
Johnius batabanus Poey, 1860:184; 1861:370; 1868: 324; 1875b:49.
Corvula batabana, Jordan & Evermann, 1898:1430.

Cotype: M. C. Z. 10926–27, 21957, three specimens 184 to 228 mm. No. Poey 85.

Type locality: Batabano, Havana Prov.

MALACANTHIDAE

Caulolatilus

Caulolatilus Gill, 1862b:240 (?*Latilus chrysops* Cuvier & Valenciennes)

128. Caulolatilus cyanops Poey
Caulolatilus cyanops Poey, 1866a:311, 312; 1868:330; 1876:95; Jordan & Evermann, 1898:2278.

Cotype: M. C. Z. 12826, 265 mm. long. No. Poey 412.

CHAETODONTIDAE

Prognathodes

Prognathodes Gill, 1862b:238 (*Chelmo pelta* Günther=*Chelmo aculeatus* Poey)

129. Chelmo aculeatus Poey
=Prognathodes aculeatus (Poey)

Chelmo aculeatus Poey, 1860:202; 1861:371.
Prognathodes aculeatus, Poey, 1868:354; 1875b:63; Jordan & Evermann, 1898:1671.

Holotype: M. C. Z. 16253. No. Poey 56.

Type locality: Matanzas.

CHAETODON

Chaetodon Linnaeus, 1758:272 (*Chaetodon capistratus* Linnaeus)

130. SAROTHRODUS AMPLECTICOLLIS Poey
=CHAETODON BIMACULATUS Bloch

Sarothrodus amplecticollis Poey, 1868:353.
Sarothrodus amplexicollis, Poey, 1875b:63, pl. 7, fig. 1–3
Chaetodon bimaculatus Bloch, 1790, pl. 219, fig. 1; Poey, 1861:371.
Sarothrodus bimaculatus, Poey, 1868:353; 1875b:62.
Chaetodon ocellatus, Jordan & Evermann, 1898:1674.

Holotype: M. C. Z. 16250. No. Poey 665.

131. CHAETODON SEDENTARIUS Poey

Chaetodon sedentarius Poey, 1860:203; 1861:371; Jordan & Evermann, 1898:1675.
Sarothrodus sedentarius, Poey, 1868:354; 1875b:62.

Types: M. C. Z. 16198, two specimens the largest of which is the holotype. No. Poey 247.

Type locality: Cienfuegos, Sta Clara Prov.

132. SAROTHRODUS ATAENIATUS Poey
=CHAETODON ATAENIATUS (Poey)

Sarothrodus ataeniatus Poey, 1868:353; 1875b:63.
Chaetodon ataeniatus, Jordan & Evermann, 1898:1676.

Holotype: M. C. Z. 16251. No. Poey 250.

POMACANTHUS

Pomacanthus Lacépède, 1803a:517 (*Chaetodon arcuatus* Linnaeus)

133. CHAETODON LITTORICOLA Poey
=POMACANTHUS PARU (Bloch)

Chaetodon littoricola Poey, 1868:351; 1875b:60.
Chaetodon paru Bloch, 1787:57.

Pomacanthus arcuatus, Jordan & Evermann, 1898: 1679.

Pomacanthus paru, Jordan & Evermann, 1898:1680.

Types: M. C. Z. 16165, two specimens, the largest of which is the holotype. No. Poey 577.

ACANTHURIDAE

Acanthurus

Acanthurus Forskål, 1775:59 (*Chaetodon unicornis*), etc.

134. Acanthurus tractus Poey
=Acanthurus bahianus Castelnau

Acanthurus tractus Poey, 1860:208; 1861:372; 1868: 356; 1875b:67.

Acanthurus bahianus Castelnau, 1855:24, pl. 11, fig. 1.

Teuthis bahianus, Jordan & Evermann, 1898:1691.

Holotype: M. C. Z. 21856. No. Poey 447.

SCORPAENIDAE

Scorpaena

Scorpaena (Artedi) Linnaeus, 1758:266 (*Scorpaena porcus* Linnaeus)

135. Scorpaena rascacio Poey
=Scorpaena plumieri Bloch

Scorpaena rascacio Poey, 1860:169; 1861:366; 1868: 303; 1875b:40.

Scorpaena plumieri Bloch, 1798:234; Jordan & Evermann, 1898:1848.

Cotypes: M. C. Z. 13948–50, 13957, 4 specimens 165 to 305 mm. No. Poey 359.

136. Scorpaena occipitalis Poey
=Scorpaena inermis Cuvier & Valenciennes

Scorpaena occipitalis Poey, 1860:171; 1861:366; 1868: 303; 1875b:41.

Scorpaena inermis Cuvier & Valenciennes, 1829b:228; Jordan & Evermann, 1898:1853.

Types: M. C. Z. 13894, 5 specimens, the largest of which is the holotype. No. Poey 474.

PERISTEDIIDAE

Vulsiculus

Vulsiculus Jordan & Evermann, 1895:489 (*Peristedion imberbe* Poey)

137. Pterystedion imberbe Poey
=Vulsiculus imberbe (Poey)
Pterystedion imberbe Poey, 1861:367, 389 (Note No. 25)
Peristedion imberbe, Poey, 1867:158; 1868:304, 462.
Peristedion micronemus Poey, 1870b:321.
Vulsiculus imberbis, Jordan & Evermann, 1898:2181.
Holotype: M. C. Z. 13566. No. Poey 523.

POMACENTRIDAE

Furcaria

Furcaria Poey, 1860:194 (*Furcaria puncta* Poey=*Heliases multilineatus* Guichenot)

138. Furcaria cyanea Poey
Furcaria cyanea Poey, 1860:196, pl. 14, fig. 4; pl. 13, fig. 21–22; 1861:370; 1868:330; 1876:104.
Chromis cyaneus, Jordan & Evermann, 1898:1547.
Holotype: M. C. Z. 14670. No Poey 460.

139. Furcaria puncta Poey
=Furcaria multilineata (Guichenot)
Furcaria puncta Poey, 1860:195; 1861:370; 1867:161; 1868:329; 1876:104.
Heliases multilineatus Guichenot, 1853:76, pl. 2, fig. 2.
Chromis multilineatus, Jordan & Evermann, 1898: 1547.
Holotype: M. C. Z. 14664. No. Poey 209.

Eupomacentrus

Eupomacentrus Bleeker, 1877:73 (*Pomacentrus lividus* Bleeker)

140. Pomacentrus xanthiurus Poey
=Eupomacentrus leucostictus (Müller & Troschel)
Pomacentrus xanthurus Poey, 1860:190; 1861:370; 1868:326; 1876:101.

Pomacentrus leucostictus Müller & Troschel, 1848:674.
Eupomacentrus leucostictus, Jordan & Evermann, 1898:1555.

Cotypes: M. C. Z. 14677a, 3 specimens 90 to 108 mm. No .Poey 481.

141. Pomacentrus caudalis Poey
=Eupomacentrus leucostictus (Müller & Troschel)
Pomacentrus caudalis Poey, 1868:328, 1876:102.
Pomacentrus leucostictus Müller & Troschel, 1848:674.
Eupomacentrus leucostictus, Jordan & Evermann, 1898:1555.

Types: M. C. Z. 14682, 7 specimens from 18.5 to 48 mm., the largest of which is the holotype. No. Poey 546.

142. Pomacentrus analis Poey
=Eupomacentrus analis (Poey)
Pomacentrus analis Poey, 1868:327; 1876:101.
Eupomacentrus analis, Jordan & Evermann, 1898:1554.

Holotype: M. C. Z. 14678. No. Poey 587.

143. Pomacentrus partitus Poey
=Eupomacentrus partitus (Poey)
Pomacentrus partitus Poey, 1868:327; 1876:102.
Eupomacentrus partitus, Jordan & Evermann, 1898:1558.

Holotype: M. C. Z. 14680. No. Poey 702.

144. Pomacentrus obscuratus Poey
=Eupomacentrus adustus (Troschel)
Pomacentrus obscuratus Poey, 1876:101.
Pomacentrus adustus Troschel, 1865:633.
Eupomacentrus adustus, Jordan & Evermann, 1898:1551.

Types: M. C. Z. 14681, 4 specimens, the largest of which is the holotype. No. Poey 586.

Stegastes

Stegastes Jenyns, 1842:63 (*Stegastes imbricatus* Jenyns)

145. Pomacentrus denegatus Poey
=Stegastes chrysurus (Cuvier & Valenciennes)
Pomacentrus denegatus Poey, 1860:190; 1861:370.

Glyphisodon chrysurus Cuvier & Valenciennes, 1830a:-356.

Microspathodon chrysurus, Poey, 1868:329; 1876:103; Jordan & Evermann, 1898:1567.

Cotypes: M. C. Z. 14672, 14675, two specimens 135 & 142 mm. No. Poey 391.

LABRIDAE

Bodianus

Bodianus Bloch, 1790:31, 33 (*Bodianus bodianus* Bloch = *Labrus rufus* Linnaeus)

146. Cossyphus pulchellus Poey
= Bodianus pulchellus (Poey)

Cossyphus pulchellus Poey, 1860:208; 1861:378.

Bodianus pulchellus, Poey, 1868:332, 459; 1876:105.

Harpe pulchella, Jordan & Evermann, 1898:1584.

Holotype: M. C. Z. 14292. No. Poey 419.

Decodon

Decodon Günther, 1862:101 (*Cossyphus puellaris* Poey)

147. Cossyphus puellaris Poey
= Decodon puellaris (Poey)

Cossyphus puellaris Poey, 1860:210; 1861:378.

Decodon puellaris, Poey, 1868:332; 1876:107; Jordan & Evermann, 1898:1584.

Types: M. C. Z. 14339, two specimens, the largest of which is the holotype. No. Poey 385.

CORIDAE

Iridio

Iridio Jordan & Evermann, 1895:412 (*Julis dimidiotus* Agassiz = *Labrus cyanocephalus* Bloch)

148. Julis humeralis Poey
= Iridio bivittata (Bloch)

Julis humeralis Poey, 1860:212; 1861:378.

Choerojulis humeralis, Poey, 1868:335; 1876:108.

Labrus bivittatus Bloch, 1791:133.

Iridio bivittatus, Jordan & Evermann, 1898:1595.

Types: M. C. Z. 14200, 3 specimens, the largest of which is the holotype. No. Poey 397.

149. JULIS INTERNASALIS Poey
=IRIDIO CYANOCEPHALUS (Bloch)
Julis internasalis Poey, 1861:421.
Chocrojulis internasalis, Poey, 1868:334; 1876:108.
Labrus cyanocephalus Bloch, 1791:139.
Iridio cyanocephalus, Jordan & Evermann, 1898:1594.
Cotypes: M. C. Z. 14252, 3 specimens 210 to 245 mm. No. Poey 258.

150. JULIS CINCTUS Poey
=IRIDIO GARNOTI (Cuvier & Valenciennes)
Julis cinctus Poey, 1860:211, pl. 13, fig. 19; 1861:378.
Choerojulis cinctus, Poey, 1868:334; 1876:108.
Julis garnoti, Cuvier & Valenciennes, 1839a:285.
Iridio garnoti, Jordan & Evermann, 1898:1593.
Holotype: M. C. Z. 14265. No. Poey 338.

151. JULIS RUPTUS Poey
=IRIDIO GARNOTI (Cuvier & Valenciennes)
Julis ruptus Poey, 1860:212, pl. 13, fig. 20; 1861:378.
Choerojulis ruptus, Poey, 1868:334.
Choerojulis cinctus, Poey, 1876:108.
Julis garnoti, Cuvier & Valenciennes, 1839a:285.
Iridio garnoti, Jordan & Evermann, 1898:1593.
Holotype: M. C. Z. 14284. No. Poey 275.

SPARISOMIDAE

CRYPTOTOMUS

Cryptotomus Cope, 1870:462 (*Cryptotomus roseus* Cope)

152. CALLIODON RETRACTUS Poey
=CRYPTOTOMUS RETRACTUS (Poey)
Calliodon retractus Poey, 1868:345; 1876:116.
Cryptotomus retractus, Jordan & Evermann, 1898: 1623.
Holotype: M. C. Z. 14461. No. Poey 558.

SPARISOMA

Sparisoma Swainson, 1839:227 (*Scarus abilgardii* Bloch)

153. SCARUS LACRIMOSUS Poey
=SPARISOMA RADIANS (Cuvier & Valenciennes)

Scarus lacrimosus Poey, 1861:422; 1868:343; 1876:113.
Scarus radians, Cuvier & Valenciennes, 1839b:153.
Sparisoma radians, Jordan & Evermann, 1898:1631.

Holotype: M. C. Z. 14538. No. Poey 632.

154. SCARUS MINIOFRENATUS Poey
=SPARISOMA AUROFRENATUM (Cuvier & Valenciennes)

Scarus miniofrenatus Poey, 1861:379, 393 (Note No. 61); 1867:164; 1868:337; 1876:111.
Scarus aurofrenatus, Cuvier & Valenciennes, 1839b: 142; Poey, 1866a:374.
Sparisoma aurofrenatum, Jordan & Evermann, 1898: 1634.

Neotypus: M. C. Z. 14545, 14547, 14550, three specimens, 225 to 227 mm. Although the name given by Poey was a substitute for that of Cuvier, these specimens were sent labeled as *miniofrenatus* by Poey. No measurements have ever been given. No. Poey 365.

155. SCARUS DISTINCTUS Poey
=SPARISOMA DISTINCTUM (Poey)

Scarus distinctus Poey, 1861:423; 1867:163; 1868:341; 1876:114.
Sparisoma distinctum, Jordan & Evermann, 1898: 1635.

Cotypes: M. C. Z. 14513, 14540, 14544, 200 to 250 mm. No. Poey 333.

156. SCARUS LATERALIS Poey
=SPARISOMA CHRYSOPTERUM (Bloch & Schneider)

Scarus lateralis Poey, 1860:219; 1861:379; 1867:162; 1868:337; 1876:112.
Scarus chrysopterus Bloch & Schneider, 1801:286; pl. 57; Poey, 1866:373, 375.
Sparisoma chrysopterum, Jordan & Evermann, 1898: 1636.

Holotype: M. C. Z. 14520. No. Poey 462.

157. SCARUS SQUALIDUS Poey
=SPARISOMA FLAVESCENS (Bloch & Schneider)

Scarus squalidus Poey, 1860:218; 1861:379; 1868:338.
Scarus flavescens Bloch & Schneider, 1801:290; Poey, 1876:113.

Sparisoma flavescens, Jordan & Evermann, 1898: 1639.

Cotypes: M. C. Z. 14519, 14522. two specimens, 320 & 360 mm. long. No. Poey 463.

158. Scarus circumnotatus Poey
= Sparisoma rubripinne (Cuvier & Valenciennes)

Scarus circumnotatus Poey, 1861:423; 1868:340; 1876:114.

Scarus rubripinne Cuvier & Valenciennes, 1839b:147; Poey, 1866a:374.

Sparisoma rubripinne, Jordan & Evermann, 1898: 1640.

Holotype: M. C. Z. 14512. No. Poey 279.

159. Scarus brachialis Poey
= Sparisoma brachiale (Poey)

Scarus brachialis Poey, 1861:345,379; 1868:337; 1876: 113.

Sparisoma brachiale, Jordan & Evermann, 1898:1641.

Holotype: M. C. Z. 14555. No. Poey 607.

SCARIDAE

Scarus

Scarus Forskål, 1775:25 (*Scarus croicensis* Bloch)

160. Pseudoscarus gnathodus Poey
= Scarus gnathodus (Poey)

Pseudoscarus gnathodus Poey, 1867:240; 1868:350; 1876:119.

Scarus gnathodus, Jordan & Evermann, 1898:1650.

Cotype: M. C. Z. 14578, 270 mm. long. No. Poey 608.

161. Pseudoscarus lineolatus Poey
= Scarus croicensis Bloch

Pseudoscarus lineolatus Poey, 1867:240; 1868:350; 1876:119.

Scarus croicensis Bloch, 1790:27; Jordan & Evermann, 1898:1650.

Cotypes: M. C. Z. 31448, 14565, 182 & 185 mm. total length. No. Poey 282.

ELEOTRIDAE

Dormitator

Dormitator Gill, 1862b:240 (*Dormitator gundlachi* Poey)

162. Eleotris omocyaneus Poey
=Dormitator maculatus (Bloch)
Eleotris omocyaneus Poey, 1860:269; 1861:381; 1867: 167.
Dormitator omocyaneus, Poey, 1868:396; 1876:128.
Sciaena maculata Bloch, 1785, pl. 299, fig. 2.
Dormitator maculatus, Jordan & Evermann, 1898: 2196.

Holotype: M. C. Z. 13372, male; paratype: M. C. Z. 13371, female. No. Poey 298.

163. Eleotris gundlachi Poey
=Dormitator maculatus (Bloch)
Eleotris gundlachi Poey, 1860:272; 1861:381.
Dormitator gundlachi, Poey, 1868:396; 1876:128.
Sciaena maculata Bloch, 1785, pl. 299, fig. 2.
Dormitator maculatus, Jordan & Evermann, 1898: 2196.

Paratype: M. C. Z. 13374, 200 mm. long. No. Poey 553.

Erotelis

Erotelis Poey, 1860:273 (*Erotelis valenciennesi* Poey = *Erotelis smaragdus* Cuvier & Valenciennes)

164. Erotelis valenciennesi Poey
=Erotelis smaragdus (Cuvier & Valenciennes)
Erotelis valenciennesi Poey, 1860:273; 1861:381; 1868:396; 1876:127.
Eleotris smaragdus Cuvier & Valenciennes, 1837b:173.
Erotelis smaragdus, Jordan & Evermann, 1898:2204.

Holotype: M. C. Z. 12567. No. Poey 203.

GOBIIDAE

Bathygobius

Bathygobius Bleeker, 1878:54 (*Gobius nebulo-punctatus* Rüppell = *Gobius fuscus* Rüppell)

165. Gobius mapo Poey
=Bathygobius soporator (Cuvier & Valenciennes)
Gobius mapo Poey, 1860:277; 1861:380; 1868:392.
Gobius soporator Cuvier & Valenciennes, 1837b:42; Poey 1876:124; Jordan & Evermann, 1898:2216.

Types: M. C. Z. 13116, 13117; both numbers in the same bottle. five specimens from 46 to 110 mm., the largest of which is the holotype, No. Poey 498.

166. Gobius lacertus Poey
=Bathygobius soporator (Cuvier & Valenciennes)
Gobius lacertus Poey, 1860:278; 1861:380; 1867:167; 1868:392; 1876:125.
Gobius soporator Cuvier & Valenciennes, 1837b:42; Poey, 1876:124; Jordan & Evermann, 1898:2216.

Types: M. C. Z. 13114, 9 specimens from 40 to 92 mm., the largest of which is the holotype. No. Poey 583.

167. Gobius brunneus Poey
=Bathygobius soporator (Cuvier & Valenciennes)
Gobius brunneus Poey, 1868:393; 1876:125.
Gobius soporator Cuvier & Valenciennes, 1837b:42; Poey 1876:124; Jordan & Evermann, 1898:2216.

Types: M. C. Z. 13110, two specimens, of which the largest is the holotype. No. Poey 650.

Gobionellus

Gobionellus Girard, 1858:168 (*Gobionellus hastatus* Girard)

168. Smaragdus costalesi Poey
=Gobionellus lyricus (Girard)
Smaragdus costalesi Poey, 1860:280; 1861:380.
Gobionellus costalesi, Poey, 1868:394; 1876:126.
Gobius lyricus Girard, 1858:169; Jordan & Evermann, 1898:2224.

Holotype: M. C. Z. 13109. No. Poey 613.

Type locality: Rio Almendares, near Puentes Grandes, Habana.

169. Smaragdus stigmaticus Poey
=Gobionellus stigmaticus (Poey)
Smaragdus stigmaticus Poey, 1860:281; 1861:380.
Gobionellus stigmaticus, Poey, 1868:294; 1876:126.
Gobius stigmaticus, Jordan & Evermann, 1898:2224.

Holotype: M. C. Z. 13104. No. Poey 289.

CHONOPHORUS

Chonophorus Poey, 1860:274 (*Chonophorus bucculentus* Poey = *Gobius banana* Cuvier & Valenciennes)

170. CHONOPHORUS BUCCULENTUS Poey
= CHONOPHORUS BANANA (Cuvier & Valenciennes)
Chonophorus bucculentus Poey, 1860:275; 1861:381.
Rhinogobius bucculentus, Poey, 1868:394; 1876:125.
Gobius banana, Cuvier & Valenciennes, 1837b:78.
Awaous taiasica, Jordan & Evermann, 1898:2236.

Cotypes: M. C. Z. 13330, 13379–80, 3 specimens, 290 to 330 mm. No. Poey 441.

171. CHONOPHORUS CONTRACTUS Poey
= CHONOPHORUS BANANA (Cuvier & Valenciennes)
Chonophorus contractus Poey, 1861:424.
Rhinogobius contractus, Poey, 1870:322; 1876:125.
Gobius banana, Cuvier & Valenciennes, 1837b:78.
Awaous taiasica, Jordan & Evermann, 1898:2236.

Holotype: M. C. Z. 31220. No. Poey 471.

MICROGOBIUS

Microgobius Poey, 1876:126 (*Microgobius signatus* Poey)

172. MICROGOBIUS SIGNATUS Poey
Microgobius signatus Poey, 1876:127, pl. 5, fig. 3; Jordan & Evermann, 1898:2246.

Types: M. C. Z. 13127, 3 specimens, the largest of which is the holotype, the other two paratypes. No. Poey 513.

SICYDIUM

Sicydium Cuvier & Valenciennes, 1837b:126 (*Gobius plumieri* Bloch)

173. SICYDIUM SIRAGUS Poey
= SICYDIUM PLUMIERI (Bloch)
Sicydium siragus Poey, 1860:278; 1861:380; 1868:395; 1876:124.
Gobius plumieri Bloch, 1786:125, pl. 178, fig. 3.
Sicydium plumieri, Jordan & Evermann, 1898:2206.

Cotypes: M. C. Z. 13328, 2 specimens 36 & 38 mm. long. No. Poey 574.

Type locality: Santiago de Cuba.

GOBIOIDIDAE

Gobioides

Gobioides Lacépède, 1800:580 (*Gobioides broussonnetii* Lacépède)

174. Gobioides barreto Poey
=Gobioides broussonnetii Lacépède
Gobioides barreto Poey, 1860:282; 1861:380; 1868:394; 1876:125.
Gobioides broussonnetii, Lacépède, 1800:580; Poey, 1866a:335; Jordan & Evermann, 1898:2263.
Holotype: M. C. Z. 13246. No. Poey 294.

ECHENEIDAE

Echeneis

Echeneis Linnaeus, 1758:261 (*Echeneis naucrates* Linnaeus)

175. Echeneis verticalis Poey
=Echeneis naucrates Linnaeus
Echeneis verticalis Poey, 1860:253; 1861:376.
Echeneis naucrates Linnaeus, 1758:261; Jordan & Evermann, 1898:2269.
Leptecheneis naucrates, Poey, 1868:376; 1875b:90.
Paratype: M. C. Z. 8709, the specimen he mentions as having 22 laminae in the disc. No. Poey 390.

Rhombochirus

Rhombochirus Gill, 1863a:88 (*Echeneis osteochir* Cuvier)

176. Echeneis tetrapturorum Poey
=Rhombochirus osteochir (Cuvier)
Echeneis tetrapturorum Poey, 1860:256, pl. 18, fig. 2; 1861:376.
Rhombochirus tetrapturorum, Poey, 1868:377; 1876:89.
Echeneis osteochir Cuvier, 1829:348.
Rhombochirus osteochir, Jordan & Evermann, 1898: 2273.
Holotype: M. C. Z. 8652. Paratypes: M. C. Z. 21805, 27228, 27229. No. Poey 130.

OPISTHOGNATHIDAE

Gnathypops

Gnathypops Gill, 1862b:241 (*Opisthognathus maxillosus* Poey)

177. Opisthognathus macrops Poey
=Gnathypops macrops (Poey)
Opisthognathus macrops Poey, 1860:287; 1861:382.
Gnathypops macrops, Poey, 1868:400; 1876:133; Jordan & Evermann, 1898:2284.
Holotype: M. C. Z. 12514. No. Poey 485.

Lonchopisthus

Lonchopisthus Gill, 1862b:241 (*Opisthognathus micrognathus* Poey)

178. Opisthognathus micrognathus Poey
=Lonchopisthus micrognathus (Poey)
Opisthognathus micrognathus Poey, 1860:287; 1861: 382.
Lonchopisthus micrognathus, Poey, 1868:400; 1876: 134; Jordan & Evermann, 1898:2287.
Cotypes: M. C. Z. 12515, 12517, 2 specimens 90 & 125 mm. long. No. Poey 357.

CLINIDAE

Malacoctenus

Malacoctenus Gill, 1860:103 (*Clinus delalandi* Cuvier & Valenciennes)

179. Myxodes macropus Poey
=Malacoctenus macropus (Poey)
Myxodes macropus Poey, 1868:399; 1876:131.
Malacoctenus macropus, Jordan & Evermann, 1898: 2357.
Types: M. C. Z. 12511, 2 specimens, the larger of which is the holotype. No. Poey 285.

BLENNIIDAE

Blennius

Blennius Linnaeus, 1758:256 (*Blennius galerita* Linnaeus)

180. Blennius vinctus Poey

Blennius vinctus Poey, 1867:243; 1868:397; 1876:129; Jordan & Evermann, 1898:2382.

Holotype: M. C. Z. 12647. No. Poey 616.

Entomacrodus

Entomacrodus Gill, 1859c:168 (*Entomacrodus nigricans* Gill)

181. Salarias margaritaceus Poey
= Entomacrodus margaritaceus (Poey)
Salarias margaritaceus Poey, 1860:289; 1861:381; 1876:132.
Entomacrodus margaritaceus, Poey, 1868:397; Jordan & Evermann, 1898:2398.

Types: M. C. Z. 12513, 3 specimens, the largest of which is the holotype. No. Poey 615.

BROTULIDAE

Stygicola

Stygicola Gill, 1863b:252 (*Lucifuga dentatus* Poey)

182. Lucifuga dentatus Poey
= Stygicola dentata (Poey)
Lucifuga dentatus Poey, 1860:102, pl. 9, fig. 1, pl. 10, figs. 5–6, 9, pl. 11, figs. 6–8, 15, 17; 1865:113.
Stygicola dentatus, Poey, 1868:401; 1876:137; Jordan & Evermann, 1898:2500.

Holotype: M. C. Z. 32329. No. Poey 255.

OPHIDIIDAE

Otophidium

Otophidium Gill, 1885:914 (*Genypterus omostigma* Jordan & Gilbert)

183. Ophidium graëllsi Poey
= Otophidium graëllsi (Poey)
Ophidium graëllsi Poey, 1861:425, 1868:402; 1876:137.
Ophidion graëllsi, Jordan & Evermann, 1898:2488.

Holotype: M. C. Z. 12440. No. Poey 480.

GOBIESOCIDAE

Sicyases

Sicyases Müller & Troschel, 1843:298 (*Sicyases sanguineus*)

184. Sicyases rubiginosus Poey

Sicyases rubiginosus Poey, 1868:391; 1876:124.
Gobiesox rubiginosus, Jordan & Evermann, 1898:2337.

Holotype: M. C. Z. 12923. No. Poey 4.

185. Sicyases carneus Poey

Sicyases carneus Poey, 1868:392; 1876:124.
Gobiesox carneus, Jordan & Evermann, 1898:2337.

Cotypes: M. C. Z. 12925, 8 specimens 16 to 24.5 mm.; no measurements were given in the original description. No. Poey 676.

BALISTIDAE

Xanthichthys

Xanthichthys Kaup, in Richardson, 1856:313 (*Balistes curassavicus* Gmelin)

186. Balistes cicatricosus Poey
=Xantichthys ringens (Linnaeus)

Balistes cicatricosus Poey, 1861:327, 361; 1863:181; 1867:171.
Xantichthys cicatricosus, Poey, 1868:435.
Balistes ringens Linnaeus, 1758:329.
Xantichthys ringens, Poey, 1876:164; Jordan & Evermann, 1898:1709.

Holotype: M. C. Z. 11953. No. Poey 97.

ANTENNARIDAE

Antennarius

Antennarius Lacépède, 1798:421 (*Antennarius bivertex* etc......Commerson = *Lophius commersonianus* Lacépède)

187. Chironectes tigris Poey
=Antennarius tigris (Poey)

Chironectes tigris Poey, 1853:217, pl. 17, fig. 2; 1861:382.

Antennarius tigris, Poey, 1868:405; 1876:134; Jordan & Evermann, 1898:2723.

Holotype: M. C. Z. 11611. Paratypes: M. C. Z. 11617, 11619, 11621, 3 specimens, 70 to 108 mm. No. Poey 207.

188. Antennarius corallinus Poey
=Antennarius multiocellatus (Cuvier & Valenciennes)

Antennarius corrallinus Poey, 1865:188; 1868:405; 1876:135.

Chironectes multiocellatus, Cuvier & Valenkiennes, 1837a:422.

Antennarius multiocellatus, Jordan & Evermann, 1898:2724.

Holotype: M. C. Z. 11620. No. Poey 301.

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CONTRIBUTION TO THE KNOWLEDGE OF THE GENUS *SMINTHURIDES* BÖRNER

By

J. W. Folsom and H. B. Mills

With Nine Plates

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INTRODUCTION

Justus Watson Folsom

(September 2, 1871 — September 24, 1936)

The bronze grasshopper which served as a knocker on the door of Dr. Samuel Scudder's laboratory in Cambridge, Massachusetts, was agitated by the hand of one of the youngsters of the neighborhood. The former student and assistant of Louis Agassiz arose, opened the door, and invited the young enthusiast with his box of butterflies across the threshold. Thus began the entomological career of Dr. Justus Watson Folsom, and thus are linked the names of three of America's most brilliant and colorful zoologists, Agassiz, Scudder and Folsom.

The entomological career which had its beginning that day in Cambridge ended in Vicksburg, Mississippi, on September 24, 1936, with Dr. Folsom's death. Between these two dates are packed endeavors, accomplishments and contributions which set a high standard among the entomologists of the world.

Very early in his training Dr. Folsom's interests began to revolve about that still poorly understood suborder of insects, the Apterygota, and this interest continued unabated until his death. His entomological textbook, especially the third edition, was a departure from the usual pattern of texts and far ahead of its time. It was the first American text to deal in any measure with the important fields of Insect Ecology and Physiology, and is a truly valuable inclusion in the entomologist's library.

Dr. Folsom was born in Cambridge, Massachusetts, September 2, 1871. Upon the death of his parents the responsibility for his training and education was shouldered by Mrs. Josephine Seymour, the mother of one of his friends. He continued to make his home with her and she with him as long as he lived. After preliminary schooling he entered Harvard College, obtaining an S.B. in 1895 and a Sc.D. in 1899 under the direction of Dr. E. L. Mark. Then followed a year as Professor of Natural Sciences at Antioch College. In 1900 he received an appointment to the Department of Entomology of the University of Illinois

remaining at that institution until 1923. In 1925 he entered the Bureau of Entomology of the United States Department of Agriculture, remaining in its service until the time of his death.

Dr. Folsom was an extremely careful worker, and if the definition of a genius is "one who has an infinite capacity for taking pains" he must be so classed. While working on the collembolan genus Orchesella in the summer of 1930 he spent several days mounting and examining many hundreds of specimens of *Orchesella hexfasciata* (Harvey), a very definite and clear-cut species and one with which he had long been familiar. "The microscopic examination of these insects is hard physical labor," he told the writer at one time, "But I am not satisfied until I have seen all that there is to see." He was constantly in search of better methods and new techniques for the examination and preservation of minute insects, and most unselfish with the information acquired. His care in giving credit to those who assisted him amounted to an obsession. He was extremely unselfish. When the writer first worked with him he pointed to a filing cabinet one day and said, "That file is full of new species which I have accumulated. Help yourself to it; work them up and describe them." That is a spirit not often demonstrated in the field of taxonomy.

The following paper is based on notes and sketches upon which Dr. Folsom was working at the time of his death.

Harlow B. Mills

The genus *Sminthurides* was proposed by Börner (1900, p. 616) to include the species *violaceus* Reuter, *aquaticus* Bourlet, *malmgreni* Tullberg, *penicillifer* Schäffer, *signatus* Krausbauer, *parvulus* Krausbauer, and *assimilis* Krausbauer, which previously had been included in the genus *Sminthurus* Latreille. The subgeneric description was as follows:

> "Tibiotarsal organ present, antennal segment IV of the male developed into a clasping organ as in many copepods. In the species known up to now the under claw of the third pair is different from the other two. The upper claw is more slender and usually longer on the first two pairs than on the third. The dorsal inner edge of the mucro differs from the outer edge; the inner edge toothed. Mucronal bristle absent."

This description was corrected later (1901, p. 6), the clasping organ of the male not limited to the fourth antennal segment and the mucronal bristle noted as present.

The same author (1901, p. 91) raised the group to generic standing, and later (1906, p. 181) indicated *Smynthurus aquaticus* Bourlet as the type.

We follow Linnaniemi (1912, p. 247) in the use of the name *Sminthurides* Börner in place of *Prosminthurus* Willem (1900, p. 55). Both of these generic names were proposed in 1900, with *S. aquaticus* Bourl. as the type (indicated later by Börner). Börner's name appeared in December, 1900, and Willem's is undated except for the year. It is very possible that *Prosminthurus* has time priority, and it certainly has page priority over *Sminthurides*. The literature for the past thirty years has almost exclusively employed the latter name, following Börner's error (1901, p. 91) of postdating the appearance of *Prosminthurus* to 1901. Until this matter can be settled definitely, it seems best to conform to usage and use the name *Sminthurides*.

Linnaniemi (1912, p. 247) observed but one pair of bothriotricha on the anogenital segment and suggested an emendation of the description to that effect. In all of the species which we have examined thus far two pairs were seen. The posterior pair is, however, subdorsal and usually much shorter and more bristle-like. On either side of the furcal segment the bases of these sensory hairs form an oblique, nearly straight line in all of the subgenera but *Denisiella*, where the bases are rather close together and form the points of a triangle.

There is a rather definite progression from *Sminthurides* s. str. through *Stenacidia* to *Denisiella*. The position of *Sphaeridia*, on the other hand, is somewhat anomolous. In the absence of a tibiotarsal organ and in the shape of the tenaculum it resembles *Denisiella*. The position of the bothriotricha of the furcal segment connect it with *Sminthurides*, while the simplification of the clasping antennae of the males isolate it from the other subgenera. Our present knowledge of the group leaves *Sphaeridia*'s position debatable.

BIOLOGY

The species of this genus are predominantly water surface and humus inhabitants, although occasionally they have been taken from beneath bark and upon grass. Some species are beautifully adapted for life on water surfaces.

Aquatic forms furnish food for small fishes.

The biology of *Sminthurides* (*Sminthurides*) *aquaticus* Bourlet has been studied by several workers, Reuter (1883), Levander (1894),

Strebel (1927), and especially Falkenhan (1932). Although this species may not be typical of all of the others of the genus it is better known, and a summary of its biology is given here.

S. aquaticus feeds almost exclusively on soft dead and living plant material, unicellular algae, fungus spores, etc. The ventral tube is not an adhesive organ, probably not functioning as such in any Collembola, but functions exclusively for respiration.

One of the conspicuous phases of copulation is the grasping of the female antennae by the male antennae, the male usually being carried about for several days completely off the water surface. Transmission of sperms takes place at the beginning of the copulation process. Females are capable of copulation before they are fully grown. Parthenogenesis does not occur.

Oviposition follows copulation ordinarily by fourteen to eighteen days, the time depending on the temperature and the copulation age of the female, and occurs in moist soil surrounding water surfaces. A female may lay as many as sixty-six eggs. Temperature largely controls the length of the egg stage, which varies from three and one-half days to five months.

S. aquaticus can remain submerged for as long as four days. If it is not hindered from so doing, it usually succeeds in getting back to the water surface in from one to two days, where it shows no ill effects from the submersion.

All of the eggs from one female develop either into males or females, and the number of male- and female-producing mothers is about equal. Only six per cent of the females observed by Falkenhan (1932) produced broods of mixed sexes.

Males moult three times and females between five and seven times, becoming sexually mature after the third moult.

Males usually live for four or five weeks and the females from two to three and one-half months. The sex ratio, which is originally about 1:1 changes later in favor of the females due to their longer life. Males and females are found together throughout their active period, and from seven to ten generations occur each season. The winter is passed normally in the egg stage, but in southern latitudes, or in exceptionally warm winters in northern regions, a few adult females may hibernate.

The chief enemy of *S. aquaticus* in Europe is the mite *Episcius sphagni* (Halbert), which is frequent about the edges and on the surfaces of small pools which the Collembolans inhabit.

Genus Sminthurides Börner 1900

Vesicles of ventral tube short, smooth, without lateral tubercles but sometimes with apical papillae. Segmentation of the body usually evident through intersegmental sutures or light lines. Corpus of tenaculum with lateral clavate processes at the bases of the rami. Integument granulate. Anal segment ankylosed with the genital segment, which is broadly united to the furcal segment. Body with five pairs of bothriotricha, three pairs on the furcal segment and two on the anogenital division. Anal appendages of female wanting. Second and third segments of the antennae of the male modified into a clasping organ, the fourth segment always simple. Antennae of female not modified, the fourth segment simple, ringed or definitely subsegmented. Tibiotarsal organ of posterior legs present or absent; when present, composed of two tooth-like eversions and a heavy spine which may be lamellate, notched, or definitely bifid. Except for the subgenus *Denisiella*, the first two pairs of ungues are longer, more slender, and usually definitely unidentate on the inner margin, differing from the posterior ungues which are shorter, broader, and usually weakly toothed or untoothed; first two pairs of unguiculi usually short and narrow, the third pair much broader and definitely lamellate; subapical unguicular filaments present, tenent hairs absent. Eyes normally eight on either side. Length seldom over 1 mm., usually much less.

Key to the Subgenera of Sminthurides Börner

1. Tibiotarsal organ of 3rd pair of legs (figure 5) present, composed of 2 sacs and an enlarged spine 2
   Such tibiotarsal organ absent 3
2. Mucronal edges with weak, or without true lamellae, dorsal inner edge toothed. Mucro slender, definitely narrowed in the apical third. Ant. IV simple (figure 89) . . . . *Stenacidia* Börner. P. 262
   Mucronal edges more or less broadly lamellate, inner lamella toothed and ribbed (figure 12). Ant. IV simple, ringed, or subsegmented . . . . *Sminthurides* Börner. P. 235
3. Mucronal bristle absent (figure 106) . . . . . . *Sphaeridia* Linnaniemi. P. 268
   Mucronal bristle present (figure 100) . . . . *Denisiella* n. subg. P. 264

Subgenus Sminthurides Börner s. str.

1843, *Sminthurus* Bourlet p. 58 (*ad. partim*). 1900, *Smithurides* Börner p. 616 (*ut subgenus*). 1900, *Prosminthurus* Willem p. 55. 1901, *Sminthurides* Börner p. 91.

Tibiotarsal organ present. Mucrones with 3 well developed lamellae, the inner always toothed; mucronal bristle present. Antennae usually longer than the head, the 4th segment simple, ringed, or definitely subsegmented. Corpus of tenaculum usually subconical, exceeding the rami of the tenaculum, and with anterior and apical bristles. Vesicles of ventral tube simple or with as many as 6 apical tubercles. Anogenital segment broadly united with the rest of the body, the 5th and 6th segments sometimes separated dorsally by a constriction. Type: *Sminthurides aquaticus* (Bourlet).

Key to the species of the subgenus Sminthurides Börner s. str.

1. Mucro apically bulbous or apparently so, with coarse teeth on inner lamella (figure 83) 2
   Mucro not apically bulbous. Inner lamella with finer teeth (figure 32) . . 4
2. Ventral mucronal lamella ending in a sharp tooth before the apex (figure 83) . . . . *lepus* Mills 1934
   Ventral mucronal lamella entire (figure 78) 3
3. Ungues stout, inner tooth beyond the middle. Mucro not hooked apically. Basal segment of fourth antennal segment related to apical about as 2:1. (figure 78) . . . . *occultus* Mills 1934
   Ungues slender, the inner tooth situated before the middle. Mucro hooked apically. Basal segment related to the apical about as 2.2–2.5:1 (figure 76) . . . . *macnamarai* n. sp.
4. Mucro trough-shaped, both sides alike (figure 88) . . . . *plicatus* Schött 1891
   Mucro not as above, the sides dissimilar 5
5. Filament of hind unguiculus of female branched (figure 45) 6
   Filament of hind unguiculus of female simple (figure 57) 9
6. Filament 2- or 3-branched. Fourth antennal segment of female ringed (figure 45) . . . . *bifidus* Mills 1934
   Filament of hind unguiculus 4- to 6-branched 7
7. Seta of organ of third tibiotarsus simple. Hind unguicular filament 4-branched (figure 40) . . . . *appendiculatus* Imms 1912
   Seta of organ of third tibiotarsus wide, bifid. Unguicular filament 5- or 6-branched 8
8. Fourth antennal segment not subsegmented. Apex of bristle of tibiotarsus III organ not attaining the base of the unguiculus. Unguicular filament of the first 2 pairs of legs simple, sharp (figure 49) . . . . *penicillifer* Schäffer 1896
   Fourth antennal segment subsegmented with 7 (?) irregular divisions. Apex of bristle of tibiotarsus III organ passing the base of the unguiculus. Unguicular filament of first 2 pairs of legs flat, lanceolate in its distal portion . . . . *pauliani* Denis 1936

9. Antennae shorter than the head (figure 1) 10
Antennae equal to or longer than the head 11
10. Mucro with 10–12 inner teeth. Vesicles of ventral tube with several terminal papillae . . . . *cruciatus* Axelson 1905
Mucro with about 9 inner teeth, apically pointed. Vesicles ? Clothing not remarkably short . . . . *hospes* Börner 1907
11. Fore unguiculi very long, lanceolate, appressed, apex exceeding apex of unguis (figure 39) . . . . *spegazzinii* Börner 1907
Fore unguiculi not as above 12
12. Fourth antennal segment of female simple 13
Fourth antennal segment of female distinctly subsegmented 17
13. Organ of 3rd tibiotarsus of male with a bifid seta, 2 elongate swellings, and a lateral blunt club (figure 3, 4) . . . . *stagnalis* Womersley 1932
Organ of 3rd tibiotarsus usually with a simple seta. Accessory club absent in male 14
14. Mucro bearing a subapical fingerlike projection. Fourth antennal segment of female with a basal subglobose portion, separated from the apical part by a constriction, apical part gradually and rather evenly narrowing to apex (figure 6) . . . . *globocerus* n. sp
Fourth antennal segment of female without a conspicuous basal globose region or finger-like projection of mucro 15
15. Mucro at least half as broad as long (figure 12). Seta of 3rd tibiotarsus organ usually extending far beyond the apex of the tibia, not lamellate. Dorsal segmentation of body evident . . *aquaticus* Bourlet 1843
Mucro one-third as broad as long (figure 30). Seta of 3rd tibiotarsal organ not greatly exceeding the apex of tibia, lamellate. Dorsal segmentation of body not evident 16
16. Abdominal segments 5 and 6 demarcated dorsally. Mucro apically rounded (figures 26, 27). Ventral tube vesicles with 6 papillae. Seta of tibiotarsal organ broad, bifid . . . . *ludovicianus* n. sp.
Abdominal segments 5 and 6 confluent. Mucrones apically pointed (figure 30). Vesicles of ventral tube simple. Seta of tibiotarsal organ tapering, normally simple lamellate . . . . . . *malmgreni* Tullberg 1876
17. Fourth antennal segment joints 7 and 8 weak ringlike subsegments, with narrow ringlike divisions between them (figure 41) . . . . *melanotus* Börner 1907
Fourth antennal segments definitely subsegmented usually with 4 or 5 subsegments 18
18. Subsegments of 4th antennal segment of female 7 or 8, none greatly longer than the rest (figure 70) . . . . *annulicornis* Axelson 1905
Antennae with 4 or 5 subsegments in the 4th segment (figure 73) 19
19. Basal subsegment subequal to the apical (figure 52) 20
Basal subsegment about twice the length of the apical (figure 79) 21

20. Fourth antennal segment of female with 4 subsegments. Mucro strongly narrowed apically and rounded . . . . *schötti* Axelson 1903
 Fourth antennal segment with 5 subsegments. Mucro not strongly narrowed apically, truncate . . . . *parvulus* Krausbauer 1898
21. Fourth antennal segment of female with 4 subsegments 22
 Fourth antennal segment with 5 subsegments . . . . *inequalis* Börner 1903
22. Mucro strongly narrowed toward the apex. Length of females 0.5 mm. Body light, with dark blue stripe on the sides and a dorsal, broken colored area (figure 58) . . . . *assimilis* Krausbauer 1898
 Mucro slightly narrowed distally. Length of females 0.35–0.45 mm. Color lighter or darker violet, pigment diffuse (figure 64) . . . . *krausbaueri* n. nom.

Sminthurides cruciatus Axelson (Linnaniemi)

Plate I, fig. 1

1905, *Sminthurides cruciatus* Axelson, p. 792.

Color of body largely dark violet. Body with a median-dorsal dark stripe with transverse branches. Sides of abdomen mostly pale, or ventrolaterally dark. On the sides, especially posteriorly, are several roundish dark spots. Anogenital segment almost entirely violet. Antennae, legs, and furcula pale violet. Head pale, marked with violet. Oral region dark. Eyes 8 on either side. Antennae clearly shorter than the head (figure 1), as 6:7, the segments about as 7:8:13:23. Last antennal segment simple, unringed. First 2 pairs of ungues slender with an inner tooth at about the middle and small lateral teeth. Unguiculi of these feet short, slender, with small lamellae, scarcely half the length of the unguis; filaments exceeding the apex of the unguis. Third pair of ungues shorter than the others, with small inner tooth and lateral teeth. Unguiculi of these feet $^2/_3$ the unguis, with broad lamellae and filaments which exceed the ungues. Organ of 3rd tibiotarsus composed of 2 elongate swellings and a short, simple, basally broad seta which extends a little beyond the tibiotarsus. Ventral tube with several papillae at the end of the vesicles. Tenaculum with the corpus conical and bearing 2 strong anterior setae; rami 3-toothed, each with a basal clavate appendage. Dens 2.3 times the mucro. Mucrones bent apically, with relatively narrow lamellae; about $^1/_3$ as broad as long; inner lamella with 10–12 teeth, narrowing toward the apex and ending in a sharp tooth-like projection, outer lamella ribbed but without teeth, ventral lamella narrow but evident. Mucronal seta present. Clothing

exceptionally sparse and short. Integument finely granulate. Length up to 0.66 mm.

Sweden, Finland.

This species occurs on water surfaces with such species as *S. malmgreni elegantus* Reut. and *S. aquaticus* Bourl., sometimes among water plants.

Sminthurides hospes Börner

Plate I, fig. 2

1907, *Sminthurides hospes* Börner, p. 172.

Weakly pigmented with violet, darker on the posterior dorsum. Dentes and mucrones pale, claws not plainly pigmented. Antennae violet, becoming darker distally. Eyes 8 on either side. Head only a little longer than the antennae, the segments of which are related about as $1:1^2/_5:2\,^1/_5:4$, or $1:1^1/_2:2\,^3/_4:4^3/_4$. Last antennal segment simple, not subsegmented. Body very highly arched. Ungues apparently without inner or lateral teeth, the first 2 pairs somewhat longer and more slender than the last (figure 2). Unguiculi on the first 2 pairs of feet with a concave inner lamella and subapical filament which attains the apex of the unguis (exceeds it in Börner's figure 40). Ungues and unguiculi of 3rd feet almost as in *aquaticus* but narrower, the filament exceeding the apex of the unguis. Tibiotarsal organ with the bristle bearing a short ventral accessory branch, scarcely reaching the base of the unguiculus. Anterior lobe of the tenaculum extending as far as the rami, apparently with only 1 seta. Dens to the mucro as 3:1, furcula short. Dens dorsally and toward the apex in some degree clearly granulate. Mucrones more slender than in *spegazzinii* and *melanotus,* recalling *signatus* Krausbauer. About 9 teeth on the inner lamella, pointed. Clothing relatively thick and long. Length up to 0.5 mm.

La Plata, Argentina.

Taken from water surface among water plants.

Sminthurides stagnalis Womersley

Plate I, figs. 3–4

1932, *Sminthurides stagnalis* Womersley, p. 16.

Light brownish violet, with a median dark stripe. Eyes 6 (?) on either side. Antennae a little longer than the head, as 6:5 in the male. Male with the usual well developed clasping organ. Ungues similar on

all feet, with no inner teeth. Unguiculi with moderately broad inner lamellae, and subapical filaments. Tibiotarsal organ with the seta short, broad, bifid. On the inner side of each posterior tibia of the male is a short strong spine above which is a longer thumb-like projection (figure 3). Mucro 0.4 the dentes, the inner lamella with strongly ribbed teeth (12 in Womersley's figure 3c), of the *aquaticus* type, with a simple pointed apex. In the male on the anogenital segment are 2 long protuberances, each with 2 or 3 subapical spines (figure 4); just behind these is a short peglike projection. Clothing sparse, of long fine hairs. Length male 0.57 mm., female 0.69 mm.

Collected on surface of stagnant pool, Denmark, West Australia.

Sminthurides globocerus spec. nov.

Plate I, figs. 5–7

Female. Ground color in light specimens pale yellow; pigment dark purple. Dorsum posteriorly purple, anteriorly pale yellow and usually crossed by 3 or 4 irregular, subparallel, purple bands which are broken on the midline; laterally purple. Head yellow dorsally, purple about the oral region. First antennal segment pale yellow with an apical mark; 2nd yellow with an apical ring; 3rd violet, pale basally; 4th entirely violet. Legs tinged with pale violet. Furcula unpigmented. Dark forms have the head and body blackish purple, sometimes almost slate black, with irregular lighter spots vaguely showing through. The venter is somewhat lighter especially at the insertion of the furcula, and the appendages darkly, diffusely purple. Eyes probably 8 on either side. Antennae definitely longer than the head, the segments about as 10:12:28:53 or 12:13:29:59. Fourth segment simple, a subbasal constriction cuts off a globose basal region which does not, however, represent a subsegment (figure 6). Beyond this constriction the segment gradually tapers to a rather acute apex. First 2 pairs of ungues rather slender, with a weak inner tooth beyond the middle and 2 lateral teeth on each side. Unguiculi narrow, rather wider basally, with subapical filaments exceeding the ungues. Ungues of the hind legs (figure 8) without the inner tooth, broader. Unguiculi broadly lanceolate with definite, well developed lamellae and filaments which exceed the ungues. Seta of tibiotarsal organ heavy, lamellate, bifid, reaching slightly beyond the apex of the tibiotarsus; the 2 basal sacs large, elongate, overhanging their insertions (figure 5). Dentes 2.2 times the mucrones, with a small inner thumblike projection. Mucro

with a prominent blunt projection dorsally at the apex. Inner dorsal lamella with 10–15 teeth, outer lamella usually with a small sub-basal tooth which is difficult to see, ventral lamella entire; mucro 3 or more times as long as broad; mucronal bristle present (figure 7). Dentes with numerous curved hairs dorsally and 3 longer suberect dorsal setae, the clothing recalling somewhat the condition in *Denisiella*. Ventral bristle formula 1,1,1,1,2,2,2,2, the 2 single basal hairs minute. Body anteriorly with short moderately heavy hairs, posteriorly with longer, more numerous, backward-curving setae. Bothriotricha of the body 3 on either side, nearly in a straight line. Anogenital segment with 2 on either side. Tenaculum with the corpus subconical, bearing 1 apical and 2 anterior bristles. Rami 3-toothed, with basal clavate appendages. Fifth and 6th abdominal segments clearly separated dorsally. Length 0.43.

Male. Coloration similar to that of the female, anterior dorsum sometimes without the dark crossbands, head mostly purple dorsally and orally. Clasping organ highly developed. Metanotum with a pair of subdorsal vesicles. Inner dorsal lamella of mucro with 10 or 11 teeth. Length 0.41 mm.

North Carolina. Asheville, February 9, 1935. A. P. Jacot. Several specimens of both sexes from *Andropogon* sod.

SMINTHURIDES AQUATICUS (Bourlet)

Plate I, figs. 9–13; Plate II, figs. 14–19

1843, *Smynthurus aquaticus* Bourlet p. 58. 1883, *Sminthurus apicalis* Reuter p. 20. 1896, *Smynthurus amicus* Folsom p. 446. 1900, *Prosminthurus aquaticus* Willem p. 6. 1900, *Sminthurus* (*Sminthurides*) *aquaticus* Börner p. 616. 1901, *Sminthurides aquaticus* Börner p. 96.

This widespread and variable species has been separated into the following forms:

var. AQUATICUS f.p.

Yellow or brownish yellow; first 2 antennal segments pale brown; 3rd and 4th purple; legs pale brownish.

This principal form of the species occurs in most parts of Europe but has not been recorded from North America.

var. VIRIDULUS (Reuter)

1891, *Sminthurus apicalis* var. *viridulus* Reuter p. 231. 1893, *Sminthurus aquaticus* var. *viridulus* Schött p. 37. *Sminthurides aquaticus* var. *viridula* Börner p. 98.

Greenish; often with a narrow dark median dorsal line. Antennae and legs tinged with purple.

This European variety has not been recorded from North America. Linnaniemi (1912, p. 260) found it abundant in sphagnum moss.

var. LEVANDERI (Reuter)

1891, *Sminthurus apicalis* var. *levanderi* Reuter p. 232. 1893, *Sminthurus aquaticus* var. *levanderi* Schött p. 37. 1901, *Sminthurides aquaticus* var. *levanderi* Börner p. 98.

Female. General color from rose pink to deep rose purple or violet; sides of the abdomen often olivaceous, with pale spots as in fig. 19. Sternum pale. Vertex yellow or whitish, with a wide median purple mark. Oral region and apices of legs blackish purple. Antennae mostly purple to violet; 1st and 2nd segments pale yellow or whitish. Legs pale purple with femora and tibiotarsi often violet. Manubrium and dentes dilute purple, dentes darker proximally and distally. Claws and mucrones pigmented. Antero-dorsum typically with strong segmented folds separated by pale intersegmental lines; the folds may, however, be weak or absent. Head with a dorsal ridge behind the vertex (figure 19). Fifth and 6th abdominal segments are not separated. Eyes 8 on either side, 2 in each group being smaller than the others (figure 9). Antennae slightly longer than the head, as 1.2:1; the 4th segment simple; the segments related as 10:14:25:51 (specimen from England) or 6:8:21:32 (specimen from Finland). First and 2nd ungues typically very slender but often comparatively stout, with an inner tooth (sometimes obscure) beyond the middle and 2 pairs of lateral teeth (figures 14, 15, 17, 18). First and 2nd unguiculi also slender with a subapical filament of variable length. Third ungues shorter than the 1st and 2nd, the inner tooth lacking (figures 13, 16). Third unguiculi subovate with a feebly subapical filament exceeding the ungues. Tibiotarsal organ with a strong bristle which extends far beyond the apex of the tibiotarsus (figure 11). Vesicles of ventral tube simple. Rami of tenaculum tridentate, with basal clavate appendages. Corpus with 2 long anterior setae and 2 smaller ones on the apex (figure 10). Dentes from 2.3 to 3 times as long as the mucrones. Mucrones convergent, spoonlike in general form, elliptical from above,

more than half as long as broad (as 32:51); inner dorsal lamella with as many as 17 teeth; mucronal seta present (figure 12). Clothing of moderate length. Posterior dorsum with stiff setae. Often the setae of head, body, antennae, and legs situated each on a black spot. There are 5 pairs of bothriotricha as usual. The first (most anterior) is on the 2nd abdominal segment, the 2nd apparently on the 3rd, the 3rd probably on the 4th; the 4th and 5th are apparently on the 5th abdominal segment. Integument minutely granulate. Length 1.0 mm.

Male. In coloration like the female. Antennae modified for clasping. Metanotum with a pair of subdorsal bladderlike eversible hyaline vesicles. Maximum length 0.5 mm.

The foreign material of *aquaticus* which has been examined consists of numerous specimens from Germany (C. Schäffer), Poland (J. Stach), Finland (W. Linnaniemi), England and Iceland (W. M. Davies). In all of this material the 1st 2 pairs of ungues are very slender, although varying somewhat in this respect. In the United States this typical form with slender ungues is present and widespread, though we record it as yet only from Massachusetts, North Carolina, Louisiana, and Utah. The prevailing form in North America is one with comparatively stout ungues. Both forms may occur in the same locality. The unguicular filament varies greatly in relative length in European material. It may extend not quite so far as the inner tooth of the unguis or it may exceed the unguis, but is commonly short on the 1st pair. In North American material with the typical slender ungues the filament is short on the anterior feet; it exceeds the unguis in the specimens with stouter ungues. The 2 vesicles of the tibiotarsal organ vary in size and form; sometimes they are slender.

Both European and American examples have on all of the ungues 2 pairs of lateral teeth which have not been mentioned in previous descriptions. This species is common on the surface of the water of ponds and streams and on various aquatic plants. It is found also on adjacent damp humus, in which the eggs are laid. Occasionally it is encountered in moss. It is not limited to fresh water but occurs also on pools of salt water.

Some of the individuals examined had desmids in the alimentary tract. *S. aquaticus* occurred with *S. malmgreni* in the stomachs of fingerling trout, but in smaller numbers than *malmgreni*. Two of the fishes had each eaten 20 springtails, and 7 had eaten in all about 70.

S. aquaticus is a common species throughout Europe and is on record from Algeria. The records indicate that it probably occurs in most parts of North America.

Maine, Massachusetts, New York, New Jersey, North Carolina, Ohio, Illinois, Iowa, Louisiana, Texas, Utah, Washington, Ontario, British Columbia, Northwest Territories (Bernard Harbor).

Sminthurides ludovicianus spec. nov.

Plate III, figs. 20–27

Head and body mostly dark purple. Abdomen laterally purple and olivaceous with pale yellow spots. Dorsum pale yellow with 3 or 4 pairs of purple bars or spots separated along the median dorsal line. Sternum pale. Head purple, pale yellow between the eyes; oral region dark purple. Antennae violet, the first 2 segments paler. Legs and furcula unpigmented or the legs pale violet. Tibiotarsi darker apically. Eyes 8 on either side of the head. Antennae slightly longer than the head, as 1.1:1, with the segments about as 15:18:41:70; 4th segment not subsegmented. Ungues almost straight (figures 20–22), with a pair of lateral teeth, and an inner tooth which is evident on the anterior 2 pairs and obscure or absent on the 3rd. Unguiculi broadest on hind feet, with subapical filament which greatly exceeds the unguis on the fore feet and about equals it on the posterior pair. Setae of the tibiotarsal organ stout, lamellate, strongly bifid, extending about to the apex of the tibiotarsus (figure 23). Vesicles of ventral tube with 6 large terminal papillae (figure 25). Corpus of tenaculum with a pair of anterior and a pair of apical setae (figure 24). Mucrones $^2/_5$ as long as dentes, apically rounded in dorsal aspect; inner dorsal lamella with about 13 teeth (figures 26, 27). Mucronal seta present. Fifth abdominal segment is deliniated from the 6th dorsally by a deep groove. Dorsum of body with stiff setae, sparse and short anteriorly and numerous and long posteriorly. Abdomen with 3 pairs of bothriotricha, 5th segment with 1 pair. Integument minutely granulate. Length of female 0.62 mm. Males were not seen.

S. ludovicianus resembles *S. malmgreni,* from which, however, it differs aside from coloration in the following respects:

	ludovicianus	*malmgreni*
5th and 6th abdominal segments	Demarcated	Confluent
Mucro	Apically rounded	Apically pointed
Vesicles of ventral tube	6-lobed	Simple
Seta of tibiotarsal organ	Short, stout, bifid	Long, tapering, normally simple.

Louisiana. Tallulah, March 2, 9, in humus in swamp, 2 females.

Sminthurides malmgreni (Tullberg)

Plate III, figs. 28–31; Plate IV, figs. 32–38

1876, *Sminthurus malmgrenii* Tullberg p. 30. 1883, *Sminthurus elegantulus* Reuter p. 204. 1896, *Smynthurus socialis* Folsom p. 446. 1900, *Sminthurus* (*Sminthurides*) *elegantulus* Börner p. 616. 1901, *Sminthurides malmgreni elegantulus* Börner p. 94. 1905, *Sminthurus* (*Sminthurides*) *malmgreni* Becker p. 9. 1905, *Sminthurides malmgreni* Axelson p. 40.

The typical form is dark purple, in alcohol often bluish black. Head paler, with whitish spots, and a large white spot between the bases of the antennae. Oral region black. Sternum, legs, and furcula pale purple. Antennae dark purple.

This form has been recorded from Finland and from some of the Arctic islands.

S. malmgreni varies greatly in coloration:

var. *nigrescens* Börner, 1901, p. 96.

Blackish dorsally, laterally with small pale spots which may coalesce into large spots. Appendages purple. Common in Finland and Germany.

var. *quadrilineatus* Ågren, 1903, p. 161.

With 4 stripes, 2 paramedian and 2 lateral. Sweden.

var. *maculatus* Ågren, 1903, p. 161.

Median dorsal stripe reduced to a small spot. Sweden.

var. *immaculatus* Axelson, 1905, p. 792.

Median stripe absent. Finland.

All of these color variations vary into each other. The last 3 occur in North American as well as Europe. The commonest variety, in both Europe and North America, is *elegantulus*.

var. elegantulus Reuter, 1883, p. 20

Female. Fresh specimens are lemon yellow with 3 wide, broken-margined purple stripes; a median dorsal stripe or mark and 2 ventrolateral stripes which continue across the head (figure 38); all three connected posteriorly by a transverse band. The median dorsal mark may assume a great variety of forms; it may even be broken into a series of transverse bars. Sternum white or pale yellow. Head mostly yellow, oral region purple to blackish. First antennal segment pale, often yellow; 2nd segment yellow or violet; 3rd and 4th segments violet. Legs pale yellow or whitish, dark purple distally; or pale purple or violet throughout. Furcula mostly unpigmented but often purple

basally and apically; sometimes pale purple or violet throughout. Head with a prominent transverse rounded ridge behind the vertex. Eyes 8 on either side, 2 on either side smaller than the others. Antennae longer than the head (as 1.3:1) with segments about as 11:14:29:48; 4th segment simple. Ungues of the 2 anterior pairs of legs slender with an inner tooth at or beyond the middle and a pair of laternal teeth (figures 33, 36). Unguiculi of these feet slender, lanceolate, with the subapical filament exceeding the ungues. Ungues of the posterior feet $^2/_3$ as long as the anterior ungues, without an inner tooth but with a pair of lateral ones (figure 35). The posterior margin of each unguis is serrate (figure 34). Posterior unguiculi subovate, with a relatively short feebly subapical filament. Seta of tibiotarsal organ lamellate basally, exceeding the tibiotarsus and often attaining the base of the unguiculus (figure 28). Vesicles of ventral tube simple. Lobe of tenaculum with 2 long anterior setae and 1 or 2 short ones on the apex (figure 31). Dentes 2.5 times as long as the mucrones. Mucrones convergent, elliptical, $^1/_3$ as broad as long; the inner dorsal lamella ends in a prominent tooth, usually with 9–12 teeth, occasionally 13–14 (figures 30, 32). Mucronal bristle present. Dorsum of body with short curving setae. Five pairs of bothriotricha are present, 3 on the abdomen proper and 2 on the 5th segment. Integument finely granulate. Length 0.65 mm.

Male. Structurally like the female, and similar also in color. Antennae modified for clasping. Dorsal segmentation of the body weakly indicated by low folds and pale intersegmental lines. Metanotum with a pair of large subdorsal elliptical organs emitting a globose hyaline vesicle. Fifth abdominal segment evident dorsally as a ridge. Five pairs of bothriotricha present. Length 0.35 mm.

The European material examined consists of specimens from Germany (C. Schäffer), Poland (J. Stach), Finland (W. Linnaniemi), England (M. Davies), and Scotland (W. Evans). In North American material, also in specimens from Finland, Poland, and England, the inner tooth of the anterior and middle ungues is seldom absent, and that of the posterior ungues is rarely present. In German specimens, on the contrary, the inner tooth is absent on the anterior 2 pairs and present on the hind ungues. Rarely the posterior margin of the hind ungues is entire instead of serrate. The serrations are present in specimens from Finland and Poland, but they are not mentioned in European descriptions.

Elegantulus is by far the commonest variety of *malmgreni* in temperate Europe and North America. It occurs on the surface of pools

and streams, on aquatic vegetation, on damp soil adjacent to bodies of water, and in damp moss. It feeds on desmids and other minute plant forms. This variety has some importance as food for young fishes. Mr. H. J. Pack, at Ithaca, N. Y., May 17, 25 and June 10, 1924, found it in the stomachs of fingerling trout which were 25-30 mm. long. One of these small fishes had eaten about 200 individuals. Twelve fishes contained a total of more than 400 of the springtails. Such a large number of individuals, scattered on the surface of the water, could hardly have been consumed accidentally.

The following records refer to the variety *elegantulus* in North America:

Massachusetts, New York, Illinois, Louisiana, Wyoming, Ontario.

SMINTHURIDES MALMGRENI var. PALUSTRIS var. nov.

This is a color variety, which structurally agrees essentially with *elegantulus*.

Female. Body laterally and often posteriorly diffuse purple, without lateral stripes; or general color maroon, blue, brownish, or ferruginous (figure 37). Ground color pale yellow. Dorsum commonly yellow anteriorly; posteriorly with a median purple mark or a pair of paramedian marks; these marks varying greatly in form. The dorsum may be entirely yellow or purple. Sides of the abdomen with small pale yellow or white spots. Sternum white or pale yellow. Head pale yellow dorsally, blackish orally, with a median maroon stripe between the eyes and a white mark bordering the inner edge of each eye. First antennal segment pale yellow, 2nd pale yellow to purple, 3rd and 4th purple. Legs whitish, purple, or brownish, with tibiotarsi commonly pale purple and darker apically. Manubrium and dentes unpigmented or dentes dull purple proximally and distally. Setae of tibiotarsal organ exceeding the segment, and sometimes extending as far as the base of the unguiculus; lamellate and often, but not always, bifid (figure 29). Clothing of moderately long setae, each on a black spot. Length 0.77 mm.

Male. In coloration similar to the female. Head and body rose purple to dull purple. Dorsum pale yellow, sides dull purple. Length 0.4 mm.

Dr. Jan. Stach, to whom examples of *palustris* were sent, reported that this variety agrees structurally with the European *malmgreni*, even to the setae of the tibiotarsal organ and the serrate posterior margin of the hind unguis.

This color variety often occurs in company with *elegantulus,* and is wide spread in North America, as the following data show:

New York: Ithaca, R. B. Hughes.

Illinois: Karnak, February 24, H. H. Ross and C. O. Mohr.

Iowa: Ruthven, October 2, H. M. Harris and B. V. Travis.

Louisiana: Tallulah, January 3, 19, 22, February 19, March 9, 15, 20, 21, April 13, 15, 18, October 12, November 11, J. W. F.

Texas: College Station, H. B. M.

Utah: Logan Meadows, Logan, May 5, G. F. Knowlton and C. F. Smith; Benson, May 3, G. F. K. and C. F. S.; N. W. Amiaga, May 4, G. F. K. and J. A. Rowe; E. Newton, May 4, G. F. K. and C. F. S.

Montana: Bozeman, August 10, H. B. M.

Washington: Yakima, April 19, A. R. Rolfs; Lake Tipsoe, October 11, A. R. R.

Ontario: Arnprior, March 2, May, June, C. Macnamara.

SMINTHURIDES SPEGAZZINII Börner

Plate V, fig. 39

1907, *Sminthurides spegazzinii* Börner pp. 170–171.

Dull straw yellow. Violet pigment on sides and posterior region of abdomen. Anogenital segment pale dorsally. Apices of tibiotarsi and antennae violet, the last 2 antennal segments especially so. Eyespots especially large and black. Frontal ocellus relatively large. Oral region dark. Eyes 8 on either side. Antennae to the head as $8^1/_8:8$ or $7\,^2/_9:7\,^1/_5$. the segments as $1:1^3/_4:2:3\,^3/_8$ or $1:1^5/_9:1^2/_3:3$. Last antennal segment simple. First 2 pairs of ungues elongate, with 1 inner tooth beyond the middle and no lateral teeth (figure 39). First 2 pairs of unguiculi awl-shaped, a little broader before the apex giving it a lance-like appearance, exceeding the unguis, with a reduced lamella close to the base. Third pair of ungues shorter and broader basally, with no inner teeth but basally and in the distal third with lateral denticles. Unguiculi of 3rd feet with concave inner lamella, filament subapical and far exceeding the unguis. Seta of tibiotarsal organ long, broadened basally, on the ventral side with 1 or 2 fine branches, reaching the base of the unguiculus; papillae elongate. Corpus of tenaculum elongate with 1 pair of long setae at level with base of rami, and 1 short apical seta. Dens to mucro as $2\,^2/_5$–$2\,^1/_3:1$. Furcula like *aquaticus*. Dentes and manubrium only dorsally uni-

formly and finely granulate. Mucro with wide lamellae, the inner one with 14 ribbed teeth. Clothing of head and body short, not abundant. Length up to 1 mm.

On water plants, La Plata, Argentina.

Sminthurides melanotus Börner

Pl. V, fig. 41

1907, *Sminthurides melanotus* Börner p. 171.

Very close to *spegazzinii*. Lamellae of first 2 pairs of unguiculi relatively longer, allowing the subapical filament to appear. On the first 2 pairs of ungues the inner tooth is a little farther distal (almost at the beginning of the last third), and the unguis beyond it is clearly constricted. Similarly, lamellae of 3rd unguiculi are relatively longer and broader basally. Antennae longer than the head, as $9\,{}^3/_8$–$8\,{}^1/_2$ or $11\,{}^3/_4$–11; the segments as $1:1\,{}^1/_8:2\,{}^5/_8:4\,{}^5/_8$ or $1:1\,{}^1/_2:3\,{}^1/_4:6$; the 3rd segment considerably longer than the 1st. Fourth antennal segment (as in *penicillifer*) ringed, with 3 to 6 discernible intermediate rings (figure 41). Dens to mucro as 3.25:1 or 2.9:1. Violet pigment finely and uniformly distributed over the entire body. Dens pale. Mucro and claws pigmented. Antennae, especially 3rd and 4th segments, dark violet. Dorsum with a narrow to broad dark violet median stripe, not sharply bounded laterally, ending above the hind coxae and shortly before the anogenital segment. Male with the usual clasping antennae and a pair of subdorsal sac-like appendages.

Taken with *spegazzinii*, La Plata, Argentina.

Sminthurides appendiculatus Imms

Pl. V, fig. 40

1912, *Sminthurides appendiculatus* Imms p. 117.

Ground color leaden. Legs and furcula paler. Antennae dark leaden, suffused with purplish. Body indigo blue, with small pale yellow markings. A pale yellow dorsal area on the head, bearing a small bluish spot between the eyes. Antennal segments as 8:11:22:32, the 4th segment simple. The first 2 pairs of claws similar, ungues very long and slender, slightly curved apically, untoothed. Unguiculi ${}^1/_5$ longer than the ungues, setiform and whiplike, usually with a minute "ventral tooth" near the base (possibly the junction between the unguiculus and filament was not noted). Posterior ungues shorter and smaller than the

others, untoothed, unguiculi with a whiplike subapical filament plus 3 slender appendages at the base of the filament (figure 40). Tibiotarsal organ with the bristle simple but broader proximally, and 2 slipper-like appendages. Ventral tube very short, with short vesicles. Mucrones very large (*aquaticus* type) with inner lamella bearing 14 teeth in Imms' figure. Mucronal seta present. Abdomen dorsally with a few short curved scattered hairs. Length 0.5–0.75 mm.

Calcutta, India.

Sminthurides bifidus Mills

Plate V, figs. 42–48

1934, *Sminthurides penicillifer* var. *bifidus* Mills p. 90.

Female. Yellow and purple; body yellow with a wide median dorsal blackish-purple stripe and broad irregular lateral stripes including the bases of the legs. The median stripe may be short and posterior or it may be broken into spots; the lateral stripes may be reduced or diffuse. Head yellow dorsally, face purple above the mouth, median frontal spot present. Eyes pigmented almost separately, the eyespots often U- or V-shaped (figure 42). First antennal segment unpigmented, 2nd partly or entirely violet, 3rd and 4th violet. Legs basally yellow and purple; femur with a purple stripe and purple apically; tibiotarsi pale, purple apically. Furcula mostly unpigmented, dens weakly pigmented apically and basally. Eyes 8 on either side, 2 on each side much smaller than the others. Antennae slightly longer than the head (1.2:1), with segments about as 10:11:20:36. Apical antennal segment annulate, with a total of 7 or 8 subsegments (figure 46), and with narrow secondary rings between the primary subsegments (evident in specimens treated with KOH). Ungues without lateral teeth, but the 3rd pair serrate distally on the posterior margin. Inner tooth usually present. Anterior and middle ungues long and slender, posterior pair shorter and heavier (figures 44, 45). Anterior and middle unguiculi with a stout subapical filament, dilating distally, exceeding the unguis and normally appressed to it. Posterior unguicular filament long, commonly split into 2 branches, but often into 3. Seta of tibiotarsal organ stout, bifid, usually extending far beyond the apex of the tibiotarsus. Vesicles of ventral tube simple, without terminal papillae. Corpus of tenaculum with a pair of anterior setae and an apical seta situated between 2 long lobes, anterior and posterior respectively; the latter lobe somewhat variable in length, rarely absent (in one male examined) (figure 43). Dentes about 2.5 times the length of the mucrones. Mucro

elliptical in dorsal aspect, about half as broad as long. Outer dorsal lamella entire, inner with as many as 16 teeth; mucronal seta present (figure 48). Dorsum of body with simple curving setae of moderate length. Five pairs of bothriotricha as usual, the posterior pair short. Length 0.7 mm.

Male. Coloration similar to that of the female but often entirely yellow dorsally. Antennae to the head as 1.7:1, with the segments about as 13:15:9:18 or 32:38:20:44, the 2 middle segments modified for clasping; 4th segment simple. Mucro suborbiculate; outer dorsal lamella entire, supported by a heavy transverse tooth-like bar; inner lamella with as many as 11 teeth (figure 47). A subdorsal pair of hyaline globose extrusible vesicles is present on the metanotum. Length 0.45 mm.

In the type specimens the pigment was dense in the females, which were blue-black with a few roundish, lighter spots showing through; the appendages were also dark, the legs and furcula, however, lighter. The subsegmentation of the 4th antennal segment of the female is not especially apparent, and is nearly invisible in young specimens. A few specimens show evidence of a tunica on the ungues but this does not seem to be characteristic.

Hundreds of individuals were received from T. H. Hubbell which were collected in Florida. Many of these had unicellular algae and plant tissue in their alimentary tracts. This species is usually an inhabitant of water surfaces, but 1 specimen was taken from moss by Mr. C. Macnamara.

Florida, Louisiana, Iowa, Minnesota, Ontario.

SMINTHURIDES PENICILLIFER (Schäffer)

Plate VI, fig. 49

1896, *Sminthurus penicillifer* Schäffer p. 211. 1900, *Sminthurus* (*Sminthurides*) *penicillifer* Börner p. 617. 1901, *Sminthurides penicillifer* Börner p. 92.

var. PENICILLIFER f.p.

A more or less broad stripe on each side of the abdomen which usually extends over the 5th and 6th abdominal segments; this stripe extends over the sides of the thorax and bases of the legs as a paler or darker violet pigmentation. Posteriorly on the 4th abdominal segment are 2 black stripes which broaden posteriorly and which are sometimes united behind; scarcely reaching the thorax anteriorly. Oral region,

antennae, legs, manubrium, and dentes more or less gray-blue. This is the coloration of both sexes. Antennae much longer than the head, the 4th segment simple or ringed, not subsegmented, the segments about as $1:1^1/_2:4\text{–}5:6\text{–}7$. Male antennae with clasping organ, the segments as $1:1^2/_5:1:2$. Eyes 8 on either side of the head. First 2 pairs of claws differ from the 3rd. Anterior ungues without teeth or tunica tunica (Schäffer), Börner (1901) shows an inner tooth; anterior unguicular filaments slender, pointed, exceeding the apex of the ungues. Posterior ungues shorter and broader than the anterior ones, often beyond the middle a weak inner tooth; posterior unguiculi weakly curved, with well developed inner and outer lamellae; the posterior unguicular filaments are divided into 5 or 6 branches at about the middle, brushlike (figure 49). Tibiotarsal organ with 2 short papillae and a broad, bifid seta. Furcula relatively large, the dens 2.3 to 3 times the mucro. Mucrones convergent, between *aquaticus* and *malmgreni* in width; inner lamella with 8–12 teeth. The ventral lamella shows traces of ribs. Corpus of tenaculum overreaching the rami, with 2 long anterior setae and 1 smaller and terminal; rami 3-toothed, with the usual basal clavate appendages. Setae of body and appendages strong, especially posteriorly on the abdomen. Integument granulate. Length, female 1.0 mm., male 0.3 mm.

var. INCOMPTUS Börner, 1901, p. 94

Eyes on black eyepatches. All other dark pigment absent. This form intergrades with the typical form.

This European species has been taken from water covered with water plants in Germany, Switzerland, Finland, and Russia. It is probably widespread at least in central and Northern Europe.

SMINTHURIDES PAULIANI Denis

1936, *Sminthurides pauliani* Denis p. 127.

"The species is very near *S. penicillifer* (Schäf.), and a comparative diagnosis will suffice. . . . For Ant. IV, Börner says: 'simple or ringed, not subsegmented.' *S. pauliani* possesses ant. IV which I would willingly qualify as 'subsegmented.' Between the false segments are seen easily clear lines, indicating without doubt something more than a superficial annulation.... Although Börner does not give a figure of the antennae I am convinced that, if he had seen what I see he would have described it. One notices then this first difference from *penicillifer:*

ant. IV female, more clearly subsegmented in the case of *pauliani* than *penicillifer*, this irregular subsegmentation tending to cut the segment into large subsegments which are separated by one or several annular swellings. In comparing the tarsal III organ of *pauliani* with fig. 11 (Taf. II) (Börner, 1901) I find that the two branches of the bifid bristle are different. In *penicillifer* the dorsal branch does not attain the base of the unguiculus, it passes it considerably in *pauliani* where the unequalness of the two branches is much greater. . . . The aspect of the claws differs clearly from that which Börner reproduces for *penicillifer;* the axes of the two claws are parallel . . . but the principal difference, upon which I propose to base a new species, resides in the fact that the unguicular bristle of the first 2 pairs of feet, instead of being 'simple, sharp,' is here flat, clearly larger than the figure 11 of Börner, very clearly enlarged and lance-shaped in its distal part. These things are so clear that it is certain that any observer would not fail to see it."

Fontainebleau Forest, France, from the surface of water.

Sminthurides schötti Axelson

Plate VI, figs. 50–52

1902, *Sminthurides sp.* Schött p. 36. 1903, *Sminthurides schötti* Axelson p. 12.

Female. Oral region dark purple. Antennae violet. Legs pale with tibiotarsi violet. Dentes unpigmented. Body high-arched. Eyes 8 on either side. Antennae slightly longer than the head as 9:8, with segments about as 1:1.5:3.5:7. Fourth antennal segment with 4 subsegments, as 7:3:3:7; basal and apical subsegments thus equal in length (figure 52). Unguis with a small inner tooth and a pair of minute lateral teeth behind the middle. Filaments of the unguiculi exceeding the ungues. Seta of tibiotarsal organ simple, attaining the end of the tibiotarsus (figure 51). Ventral tube with several (6?) terminal papillae. Dentes from 2 to 2.2 times the length of the mucrones, each with an inner distal tooth. Mucrones apically swollen spoon-shaped, with relatively narrow lamellae (figure 50). Inner dorsal lamella with 10–15 teeth; ventral lamella ending before the apex; mucronal bristle present. Setae of dorsum sparse anteriorly, longer and more numerous posteriorly. Three pairs of bothriotricha on the body and 2 pairs on the anogenital segment. Integument minutely granulate. Length 0.4 mm.

Male. Antennae much longer than the head (as 12–8), modified for clasping. Length 0.20–0.25 mm.

Axelson (1903) designated 3 forms of this species, which associate together and intergrade with each other.

var. SCHÖTTI f.p.

Yellowish throughout, or pale violet or reddish. Antennae violet, the last 2 segments darker. Oral region dark violet or blue. Finland, Scandinavia.

var. BILINEATUS Axelson, 1903, p. 13

Posterior region of abdomen with a pair of narrow dark violet or blue stripes. Finland, Norway.

var. ORNATUS Axelson, 1903, p. 13

Dorsum with a broad dark median stripe. Median line pale, narrow, with lateral transverse branches. Abdomen with a spot on either side. Finland.

Specimens of this species which we have examined, received from Dr. M. Kseneman of Czechoslovakia, agree with the description of Linnaniemi (1912, p. 267). According to Linnaniemi this species is commonest in bogs in sphagnum moss, occurring less frequently on the surface of water. It occurs not only on fresh water but also on salt water in rock pools.

Finland, Norway, Germany, England, Czechoslovakia.

SMINTHURIDES PARVULUS (Krausbauer)

Plate VI, figs. 53, 54

1902, *Sminthurus parvulus* Krausbauer p. 27.

Bluish violet, sides of the abdomen with grayish white spots. Head yellowish brown; mouth dark violet. Eyespots black, bordered mostly with yellow. Frontal spot quadrate. First 2 antennal segments brownish yellow, 3rd and 4th violet. Sternum and legs pale violet. Furcula almost unpigmented. Antennae longer than the head, the 4th segment as long as the 3 preceding combined and with 5 subsegments; proximal and distal segments subequal, intermediate segments smaller and subequal. Unguis slender, without teeth. Unguiculus untoothed, slender on the first 2 pairs, broader on the last, with simple filaments which exceed the unguis. Dentes 2 times the mucrones. Mucro spoon-like, $^1/_3$ as broad as long. Outer (?) lamella toothed, toward the distal

end somewhat broadened, ending in a wide, blunt tooth (figure 53, 54). Mucronal edges widely open distally. Length 0.25–0.30 mm.

This species was described from specimens collected in Germany from the surfaces of pools in wooded areas.

Sminthurides assimilis (Krausbauer)

Plate VI, figs. 55–61

1902, *Sminthurus assimilis* Krausbauer p. 28. 1901, *Sminthurides assimilis* Börner p. 138.

Female. Yellow and purple. Sides of body blackish purple, this pigment usually continued behind around the abdomen, and also across the head. Dorsum of body yellow with pairs of blackish purple spots as in figure 59–61. Head yellow above, face blackish purple above the mouth. First 2 antennal segments unpigmented or the 2nd violet apically; 3rd and 4th dark violet. Legs weakly pigmented; femora spotted with violet; tibiotarsi violet, darker apically; or legs violet throughout. Furcula unpigmented or slightly pigmented; manubrium spotted with violet, dentes also basally and apically. Eyes 8 on either side, 2 in each group smaller than the rest. Antennae longer than the head as 1.2:1, with segments about as 19:20:39:69. Apical antennal segment with 4 subsegments of the proportions 35:9:10:15 or 38:13:10:19 or 43:12:12:21; the basal subsegment twice as long as the apical (figure 55). Ungues with a pair of lateral teeth and with an inner tooth beyond the middle, which is weak or absent on the hind feet (figure 56, 57). Unguiculi much broader on the hind feet, each with a simple subapical filament exceeding the unguis. Seta of tibiotarsal organ exceeding the tibiotarsus, simple, lamellate; the basal papillae strong. Vesicles of ventral tube with 6 (?) blunt conical terminal papillae. Corpus of tenaculum with a pair of long curving anterior setae and a 3rd subapical bristle. Rami tridentate with basal clavate appendages. Mucro $^2/_5$ as long as the dens, spoonshaped, $^1/_3$–$^2/_5$ as broad as long. Outer lamella entire or with a single tooth; inner with 10–13 teeth, terminating in a sharp, toothlike projection (figure 58). Mucronal seta present. Body setae of moderate length, sparse. Five pairs of bothriotricha present on the abdomen, 2 pairs of which are on the 5th segment, the posteror pair long. Integument minutely tuberculate. Length 0.5 mm.

Male. Yellow above, purple along the sides, with the usual clasping antennae. Length 0.44 mm.

This species occurs on water surfaces and also in humus.

Massachusetts, Louisiana, Texas, Ontario, Germany, Finland, Russia.

Sminthurides krausbaueri nom. nov.

Plate VI, figs. 62–65

1902, *Sminthurus signata* Krausbauer p. 26 (nec *Smynthurus signata* (Fab.) Templeton).

The *Podura signata* of Fabricius (Ent. Syst. t. II, p. 65) was referred to the genus *Smynthurus* by Templeton (1835, p. 97) and there listed by him as *Smynthurus signata* Fabricius. Nicolet followed Templeton in this assignment (1841, p. 81). Under Art. 35 of the International Rules of Zoological Nomenclature, *Sminthurus signatus* Krausbauer (1898) becomes a primary homonym of *Smynthurus signata* (Fab.) Templeton, and the former name is not tenable.

var. krausbaueri f. p.

Yellowish brown, a distinct median dorsal pale yellow mark enclosing a still lighter cross-shaped mark. Two irregular subdorsal dark brown stripes. Clear lateral spots. Head yellowish, oral region dark. Eyespots black, bordered mesally with yellow. Quadrate frontal spot present. First 3 antennal segments yellowish brown; 4th violet. Sternum, legs, and furcula pale to colorless. Antennae longer than the head, 2nd segment longer than 1st; 3rd about equal to the basal 2; 4th equal to the rest of the antenna, with 4 subsegments, the proximal equalling the distal. Ungues slender, untoothed, without tunica. First 2 pairs of unguiculi slender with a long filament, 3rd pair with a long filament. Seta of tibiotarsal organ simple (no lamella), reaching almost to the end of the segment. Dens 2 times the mucro. Mucro spoon-shaped, $^1/_3$ as broad as long; outer (sic) lamella toothed, not reduced distally, somewhat turned up. Border not closed distally, with a shallow sinuate opening. Length 0.25–0.35 mm. Germany.

var. distinctus Linnaniemi, 1912, p. 262

Dorsum of body blue or purple, sides of body with round pale spots. Segmentation evident dorsally, the segmental lines pale. Head mostly bluish. First antennal segment pale basally, blue apically; remainder

of antenna blue. Legs blue. Manubrium and dentes pale blue. Eyes 8 on either side. Antennae longer than the head (as 1.3:1); segments about as 3:5:10:15; 4th segment with 4 subsegments, the proximal twice as long as the distal; an additional intermediate subsegment may be indicated (figure 65). Ungues strongly curved; without inner teeth (figure 62), with a pair of minute lateral teeth (seen only on the fore feet of the single specimen examined). First 2 pairs of unguiculi slender, with subapical filaments which greatly exceed the unguis; 3rd unguiculi broadly lanceolate with a subapical filament. Tibiotarsal organ with a simple bristle which extends slightly beyond the tibiotarsus (figure 63). Corpus with 2 anterior setae; rami tridentate with basal clavate appendages. Dentes to mucrones as 11:5. Mucro with outer lamella entire; inner lamella about 10-toothed; mucronal seta present (figure 64). Bothriotricha as usual, 5 pairs, the posterior pair short. Integument weakly granulate. Length, female, 0.6 mm.

We have examined one female which we refer to this variety.

Kelly Lake, Ontario, May 11, 1931. H. G. James. Finland.

Sminthurides inequalis Börner

1903, *Sminthurides inequalis* Börner p. 160.

Dark blue; sternum somewhat paler. Eyes 8 on either side. Antennae longer than the head; segments 2:3:4: as $1:1\frac{2}{3}:3\frac{2}{7}$; 4th segment with 5 subsegments, of the proportions $2\frac{2}{5}:1:1\frac{1}{6}:1\frac{1}{6}:$-$1\frac{2}{3}$. Anterior and posterior ungues not differing greatly in length, a little longer and more slender on the anterior 2 pairs. Inner and lateral teeth absent. First 2 pairs of unguiculi with subapical filaments, exceeding the unguis slightly, very small inner and broader outer lamellae with straight margins; 3rd unguiculi with small outer and broader inner lamellae, the filaments somewhat exceeding the ungues. Seta of tibiotarsal organ slender and simple. Furcula slender. Dens $2\frac{1}{3}$ times the mucro; mucro with a broad inner, very small ventral, and $\frac{3}{4}$ length outer lamella. Inner lamella with 7 teeth. End of mucro bent upward as in *S. violaceus,* free, without lamellae. Vesicles of ventral tube very short. Corpus of tenaculum with 2 pairs of setae; rami tridentate. Body hairs not thick but relatively long and fine. Length 0.75 mm.

This species was described from 1 specimen collected from beneath a flower pot in the Botanical Gardens, Palermo, Italy.

Sminthurides annulicornis Axelson

Plate VIII, figs. 66–70

1905, *Sminthurides annulicornis* Axelson p. 793.

Dark blue, including head, antennae, legs and furcula. Unpigmented spots and streaks on the sides of the body. Sternum somewhat paler. Eyes 8 (?) on either side. Antennae very slender and long, 1.5 times the length of the head; 4th segment with 7 moniliform subsegments (figure 70). First and 2nd pairs of ungues (figure 67) with a very small inner tooth and minute lateral teeth; 1st and 2nd pairs of unguiculi narrow, with weak lamellae, the filament exceeding the unguis. Third ungues much broader, with very minute inner and lateral teeth (figure 66); unguiculi very broad, with rounded lamellae. Filament long, exceeding the claw. Seta of tibiotarsal organ exceeding apex of that segment, lamellate basally and obscurely bifid. Sacs of ventral tube with apical papillae (figure 68). Dens 3 times the mucro. Mucrones somewhat convergent, about as wide as *penicillifer*, narrower than in *aquaticus;* inner lamella with about 12 teeth, lateral and ventral lamellae ribbed (figure 69). Clothing fine and sparse. Three pairs of bothriotricha on the body and 1 pair on the anogenital segment. Integument granulate. Length 0.6 mm.

In many respects this species is close to *aquaticus*.

One specimen, taken at Pottageville, Ontario, is assigned to this species. In this specimen, however, the apex of the ventral tube is furnished with a half-dozen papillae. Linnaniemi (1912, p. 261) states that they are apparently absent in *annulicornis*. The basal subsegment of the 4th antennal segment is weakly separated into 2 divisions. The subsegmentation in general is strongly developed in the specimen at hand, the reagents having pulled the inner tissue away from the chitinous covering, or perhaps the specimen was ready to moult.

Finland, Ontario.

Sminthurides macnamarai spec. nov.

Plate VII, figs. 71–76

Female. Body and head mostly purple; head paler. Body laterally purple or olivaceoüs with many pale spots. Antennae violet. Legs dilute purple. Furcula unpigmented, sometimes, though, pigmented even to the mucrones. As a variation the dorsum may be ferruginous, the body with more or less blue; first 2 antennal segments ferruginous, 3rd and 4th violet; legs and furcula tinged with violet, the tibiotarsi

pale brownish. Eyes 8 on either side, the 2 inner eyes of each group much smaller than the others. Antennae long and slender, 1.2 to 1.4 times the length of the head, with segments about as 10:13:26:45. Fourth segment normally with 4 subsegments, about as 28:8:6:13 (figure 73). The basal segment is from 2.2 to 2.4 times the length of the apical. Fifth abdominal segment evident as a rounded ridge which is demarkated anteriorly and posteriorly by a suture. Ungues with an inner tooth before the middle and a pair of lateral teeth (figures 71, 72), inner tooth of hind unguis very small. First 2 pairs of unguiculi sublanceolate, 3rd subovate; the subapical filaments simple, exceeding the ungues. Setae of tibiotarsal organ bifid, attaining or slightly exceeding the segment. Vesicles of ventral tube with papillae. Dentes from 2.2 to 2.4 times the length of the mucrones, with an inner subapical tooth and a rather heavy subapical dorsal bristle. Mucrones with the midrib projecting as a strong tooth; with lamellae apically truncate and rounded; outer lamella entire, inner lamella with as many as 13 teeth; mucronal bristle present (figures 74–76). Clothing of dorsum anteriorly sparse, posteriorly moderately long and slender, especially just before the anogenital segment. Three pairs of bothriotricha on the body and 2 pairs on the 5th segment. Maximum length 0.52 mm.

Male. In coloration and structure similar to the female. Antennae with the usual clasping organ, the 4th segment simple. Metanotum with a dorsal pair of vesicles, rather close together. Length 0.22 mm.

In young females the 4th antennal segment is not subsegmented. In old females the 4th segment occasionally has a 5th subsegment delineated. In one female the posterior edge of one hind unguis was irregularly serrate.

Iowa: Leon, October 10, B. V. Travis.

Louisiana: Tallulah, April 20, in damp humus under dead leaves, J. W. F.

Canada: Arnprior, Ontario, June, August, September, in damp moss, C. Macnamara. These specimens were in the company of *S. occultus* and *S. assimilis.*

SMINTHURIDES OCCULTUS Mills

Plate VII, figs. 77–81

1934, *Sminthurides occultus* Mills p. 91.

Female. Yellow, marked with purple (figure 81). On each side of the body is a wide purple stripe with irregular margins. Dorsum

yellow with a pair of longer or shorter subdorsal stripes that usually join the lateral stripes posteriorly, and sometimes anteriorly. Head mostly yellow, oral regions purple. Antennae largely purple, the 1st segment pale. Legs yellowish, tibiotarsi pale purple distally. Sternum and furcula unpigmented. Eyes 8 on either side. Antennae longer than the head, as 1.3:1. Segments about as 5:10:21:43, or 8:11:22:45; 4th segment with 4 subsegments, in relative lengths about as 20:7:6:10, the basal segment thus 2 times as long as the apical (figure 79). Ungues with a tunica, stout, 2 pairs of lateral teeth and a small inner tooth beyond the middle (figure 80). Unguiculi with simple subapical filaments which exceed the unguis and which are weakly knobbed. Seta of tibiotarsal organ sometimes slender and extending almost to the end of the tibiotarsus, but usually shorter and stout, occasionally conical and lamellate or weakly bifid. Vesicles of ventral tube ending in blunt conical papillae (figure 77). Corpus of tenaculum with a pair of long anterior setae; rami tridentate with the usual basal clavate appendages. Dentes 2.5 times the mucrones, which are bulbous apically and with a mucronal seta (figure 78). Outer dorsal lamella entire, with 6–8 teeth. Ventral lamella entire. Dorsum with rather long stiff setae, longer and more abundant posteriorly. Five pairs of bothriotricha, 2 of which are on the 5th abdominal segment. Length 0.4 mm.

Male. Antennae longer than the head, as 1.5:1, the segments as 12:21:14:25; modified for clasping. A pair of subdorsal hyaline metathoracic vesicles. Length 0.27 mm.

This species is one of the most common members of the genus inhabiting moss and leaf mould in North America.

North Carolina, Iowa, Ontario, Manitoba (Churchill).

Sminthurides lepus Mills

Plate VIII, figs. 82–87

1934, *Sminthurides lepus* Mills p. 91.

Female. Dark blue or blackish purple and white. Characteristic is a large dorsolateral white spot on either side of the abdomen; the 2 spots commonly but not always confluent dorsally (figure 84). Abdomen mostly pigmented laterally and posteriorly. Anterior region of dorsum mostly white. Fifth abdominal segment often blue anteriorly or entirely, 6th segment, also the sternum posteriorly, white. Head white with oral region dark. The white areas are sometimes tinged with yellow, especially anteriorly. Antennae purple, darker distally, the

1st segment paler and sometimes brownish. Legs unpigmented beyond the coxae or trochanters, or the tibiotarsi dilute purple distally. Eyes 8 on either side. Antennae longer than the head, as 1.3–1.6:1, the segments about as 20:23:52:90, 4th typically with 5 evident subsegments, in relative lengths about as 31:11:12:10:17; occasionally there are 6 subsegments or the basal segment is 2-lobed and obscurely represents 2 subsegments (figure 87). Small annulations are represented at the articulations of the definite subsegments. All ungues have a tunica, an inner tooth, and a pair of lateral teeth (figure 86). Filaments of the unguiculi reduce in length posteriorly: exceeding the unguis on the 1st paid, subequal or slightly exceeding the unguis on the 2nd, and subequal on the 3rd; they are weakly knobbed. The seta of the tibiotarsal organ is simple or weakly bifid, short, not attaining the apex of the tibiotarsus (figure 85). Corpus of tenaculum short, with 3 anterior setae, close together, the single one nearer the apex; rami tridentate with the usual clavate basal appendages (figure 82); the tenaculum in some respects resembles the condition in *Denisiella*. Dens 2.5 times the length of the mucro; mucro with an apical bulb; outer dorsal lamella entire; inner dorsal lamella with 7–11 teeth; ventral lamella ending in a subapical tooth (figure 83). Mucronal seta present. Five pairs of bothriotricha present, 3 on the 4th abdominal segment, and 2 on the anogenital segment. Dorsum of body with moderately long stiff setae, sparse anteriorly. Integument pseudotuberculate, appearing granulate but the surface smooth. Length 0.53 mm.

Male. Similar in color and structure to the female, but with the usual modification of the antennae for clasping. A pair of metanotal hyaline eversible sacs present. Length 0.27 mm.

In small individuals, about 0.3 mm., the 4th antennal segment shows no trace of subsegmentation.

This species is a rather common inhabitant of moss and leaf mould, and is rather widespread in North America.

Iowa, Illinois, Louisiana, North Carolina, Ontario.

Sminthurides plicatus (Schött)

Plate VIII, fig. 88

1891, *Sminthurus plicatus* Schött p. 13.

The ground color is white with a light reddish tinge. The head is light but for the especially large black eyespots and a black spot in the region of the mouth. The thorax is entirely light, the abdomen fur-

nished with 2 lateral and 1 median dark stripes. These bands extend along the whole length of the abdomen and are so broad that the light color appears only as 2 oval spots on the sides of the animal, as a result of which it is very difficult to decide whether the light or the dark color is the ground color. The legs and the furcula are weak violet, the antennae dark blue-violet. The apical segment of the antenna is clearly annulate, and has only five distinct sub-segments; the 3 intermediate divisions are small and of equal size, the 1st and last on the contrary longer and subequal to each other. On these it is possible to see further tendency toward subsegmentation. Tenent hairs absent. The mucro is as peculiar as it is beautiful (figure 88). It is trough-shaped, the outer edges thin and folded. It ends in a ring. Whether this is a light aberration or a frame for a chitin membrane is not evident.

This California species was described from 2 specimens, and has not since been recorded. Doubtless, when it is again studied the description will be emended.

California.

Subgenus Stenacidia Börner, 1906, p. 182

Antennae of female a little shorter than the head, the 4th segment simple. Ungues tunicate (weakly in *violaceus*). Mucro with upturned apex and very weakly lamellate, the inner lamella toothed. Mucronal bristle present or absent. Integument finely granulate. Tibiotarsal organ present. Type *S.* (*Stenacidia*) *violaceus* (Reuter).

Key to the species of the subgenus Stenacidia

Dorsum with about 15 very long strongly curving feathered hairs..........
hystrix Börner 1903. P. 263
Dorsum without long curving feathered hairs....*violaceus* Reuter 1878 P. 262

Sminthurides (Stenacidia) violaceus (Reuter)

Plate VIII, fig. 89

1878, *Sminthurus violaceus* Reuter p. 203. 1900, *S.* (*Sminthurides*) *violaceus* Börner p. 616. 1901, *Sminthurides violaceus* Börner p. 98. 1906, *Sminthurides* (*Stenacidia*) *violaceus* Börner p. 182.

Violet, paler or darker, sometimes the back clear and practically unpigmented. Sides of the body with clear streaks and spots. Sternum paler. Head violet, oral region always dark; a black spot between the

antennae. Legs and antennae violet. Antennae a little shorter than the head, the 4th segment simple. Unguis with an inner tooth and a very delicate tunica, inner tooth apparently absent from hind feet. First 2 pairs of unguiculi narrow, the 3rd broad and shorter; filaments exceed the unguis and are clearly knobbed. Tibiotarsal organ with the seta simple, not lamellate, short, somewhat broadened basally. Ventral tube without appendages. Mucro slender, the inner edge toothed (figure 89); no true lamellae occur; distally suddenly narrowed. Mucronal bristle present. Dentes strongly divergent, at the most 2.5 times the mucrones. Corpus of tenaculum with 2 pairs of long setae; rami tridentate, with basal appendages. Bothriotricha (Linnaniemi, 1912, p. 251) present as 3 pairs on the body and 1 pair on the anogenital segment. Male with the usual clasping organ. Length 1 mm.

This species inhabits the surface of pools, decaying wood, grass, etc. It has not up to the present been recorded from North America.

Germany, Finland, Scandanavia, Poland, England, Australia.

Sminthurides (Stenacidia) hystrix Börner

1903, *Sminthurides hystrix* Börner pp. 161–163.

Dark violet, broken here and there by clearer spots. Sternum pale. Several clear spots on coxae. Juveniles paler and in alcohol somewhat reddish. Ends of the legs and antennae always dark violet. Eyes 8 on either side. Antennae short, $^7/_8$ as long as the head, the segments as $1:1\,^1/_5:1^1/_5:2\text{-}2\,^1/_7$; 4th segment simple. Ungues all of about equal length, with a strong inner tooth near the middle and a pair of lateral teeth $^2/_3$ from the apex. Tunica evident. First 2 pairs of unguiculi little different from the 3rd. Filament subapical, thickened. Seta of tibiotarsal organ broadest at the middle, distally strongly narrowed, pointed, simple. Basal teeth or swellings strong. Tenaculum plump, anterior lobe with 1 strong seta, posterior part hidden between the rami which are 3-toothed and bear a basal clavate appendate. Furcula slender; dens to mucro as $2\,^1/_4:1$. Inner dorsal lamella with about 22 fine teeth. Outer margin *without* lamella. End of mucro a little bent. Mucronal seta absent. Integument finely granulate. Thorax and abdomen with about 15 very long, strong curving feathered setae which are rather rough at the apex. Three pairs of bothriotricha are present on the 4th abdominal segment and 1 pair on the 5th. Length up to 0.8 mm.

The heavy, fringed hairs are characteristic of this species. In many respects it resembles *violaceus* (Reuter).

Collected from beneath flower pots in the Botanical Gardens of Palermo, Italy. Possibly not a native of that country.

Subgenus Denisiella subgenus nov.

Apical antennal segment simple. Tibiotarsal organ of 3rd pair of legs absent. Corpus of tenaculum considerably shorter than the rami, with anterior but not apical bristles. Mucronal lamellae very weak, the outer lamella ending short of the apex. Mucronal bristle present. Postero-internal face of the hind bitiotarsi with several (unusually 5) heavy, crenulate bristles; similar bristles on the apex of the 1st and sometimes the 2nd tibiotarsi and near the anus. Claws of all feet similar. Bases of bothriotricha of body forming a triangle. Males with clasping antennae and 4 swellings at the base of the anterior tibiotarsi. Anogenital segment strongly constricted. Type: the excellently described *Sminthurides seurati* Denis.

Key to the species of the subgenus Denisiella nobis

1. No crenulate or serrate bristles near the anus .... *serrosetosa* Börner 1908. P. 264
   Crenulate bristles situated near the anus 2
2. Two crenulate bristles near the anus ....*seurati* Denis 1925. P. 265
   Six crenulate bristles near the anus 3
3. Longest dorsal bristles longer than the mucro. Second antennal segment longer than the 3rd..................*ramosus* Folsom 1932. P. 266
   Longest dorsal bristles 2/3 the length of the mucro. Second antennal segment shorter than the 3rd..........*sexpinnatus* Denis 1931. P. 267

Sminthurides (Denisiella) serrosetosa Börner

Plate VIII, figs. 90, 91

1908, *Sminthurides* (*Stenacidia*) *serrosetosa* Börner p. 58.

Female. Dark violet throughout; tibiae and furcula paler. Antennae very short, a little more than half the length of the head, the segments as $1:1^4/_5:1^2/_5$ or $1^2/_9:1^1/_9:1:2$. Second segment swollen basally (figure 90). Ungues alike on all of the feet, with 1 inner tooth and a row of sub-basal external denticles (figure 91). Unguiculi small, only slightly widened basally, bearing short filaments which do not reach the apex of the ungues. Tibiotarsal organ absent, but posterior tibiotarsus with serrate bristles which have many teeth. Dens 2 to 2.5 times the length of the mucro. Inner border of the mucro finely toothed

outer narrow, ending just before the apex; constricted at the distal third. Mucronal seta present. Corpus of tenaculum short, broad, with 2 anterior setae. Clothing sparse and rather short. Setae of legs and antennae with roughened surfaces. Length 1.1 mm.

Male. With the usual clasping antennae, the segments about as 5:7:4:5.5. Crenulate bristles of hind tibiotarsus two-toothed. Inner tooth absent from the ungues. Unguicular filaments knobbed on the 1st 2 pairs of legs. Antennae slightly longer than the head, as 43:40. Metanotum with a pair of dorsal vesicles. Length 0.45 mm.

South Africa.

Sminthurides (Denisiella) seurati Denis

Plate VIII, figs. 92, 93

1925. *Sminthurides seurati* Denis p. 273.

Female. Cream white, often with violet on the back and frons. The violet may extend and cover the entire back; it may also be quite intense. Legs and furcula always violet. Sternum light. Eyes 6 on either side of the head, 2 frontal ocelli present. Antennae a little shorter than the head, the segments as 12:15:17:29, the 4th segment not subsegmented. First tibiotarsus with a strong toothed bristle on the anter-inner extremity; 3rd tibiotarsus with 5 strong toothed setae on the postero-inner face, the most proximal the smallest. Ungues alike on all feet (figure 92), an inner tooth present but often difficult to see. Lateral teeth absent, but a sub-basal transverse outer row of denticles is present. Unguiculi alike on all feet; straight, the filament exceeding the unguis. Corpus of tenaculum short, broad, with 2 anterior setae. Rami tridentate, with basal clavate structures (figure 93). Dens about 2.6 times the mucro. Mucro somewhat *Stenacidia*-like, with definite lamellae. Outer lamella entire, extending almost to the apex; inner lamella serrate. Mucronal bristle present. Two short serrate bristles near the anus. Length 0.8 mm.

Male. Pale or weakly violaceous. Antennae about 1.5 times the length of the head, the segments about as 5:4.5:2:4, modified for clasping. First tibiae curiously modified: dilated proximally, and externally with 4 linear swollen organs. Inner tooth difficult to see on the hind feet. Inner teeth of the mucro less in number than in the female. Olfactory hairs of the 4th antennal segment more highly developed than in the female, 2 externo-ventral and 1 externo-dorsal. Length 0.6 mm.

Taken from the surface of water, Mangareva Island, Rikitia.

SMINTHURIDES (DENISIELLA) RAMOSUS Folsom

Plate VIII, Figs. 94–101

1932, *Sminthurides ramosus* Folsom p. 72.

Female. Head and body mostly purple. Sternum unpigmented. Antennae dull to clear purple throughout. Legs pale, tinged with purple. Manubrium slightly pigmented; dentes unpigmented. Eyes at least 12, possibly 16, on black spots. Antennae subequal to the head in length, elbowed between the 1st and 2nd segment, with segments about as 10:16:15:27. Organ of 3rd antennal segment with a pair of oval or subreniform lobes. Fourth antennal segment simple; olfactory setae not evident. Thoracic segmentation not evident dorsally. Genital and anal segments ankylosed into a single, well-constricted mass. Fore tibia with 1 stout disto-ventral weakly serrate seta (figure 95); middle tibia with a stout scarcely crenulate bristle in the same position (figure 96); hind tibia with 5 crenulate setae (figure 94). Unguis slender, with an inner tooth a little beyond the middle, 2 pairs of lateral teeth, and 1 minute basal tooth externally; similar on all feet (figures 97, 98). Unguiculus half as long as the inner margin of the unguis, slender, tapering, with a subapical filament longer than the unguiculus and exceeding the unguis; knobbed or not. Tibiotarsal organ absent. Vesicles of ventral tube smooth-walled. Dentes with strong simple curving setae dorsally, a dorso-median row expanded basally and half the length of the mucro; 3 dorsal bristles longer and more erect than the rest; ventrally with many short stiff appressed setae except basally. Mucro with the outer margin notched or entire; inner margin serrate and with a basolateral mucronal seta (figures 100, 101). Rami of tenaculum tridentate, with basal clavate appendages; corpus short, with 2 (rarely 3) anterior setae (figure 99). Head and body with strong stiff spinelike setae, some of which are weakly rugose; the longest dorsal bristles are longer than the mucro and the longest anogenital bristles are more than half its length. The anus surrounded by crenulate hairs. In the manner of branching these setae vary considerably. Five pairs of bothriotricha are present; 3 pairs on the dorsum, their bases forming a flat equilateral triangle; 2 pairs on the anogenital segment. Integument weakly granulate. Length 1.0 mm.

Male. Body and antennae purple. Legs tinged with purple. Furcula unpigmented. Antennae remarkably stout, a third longer than the head, with segments as 10:9:4:8. Middle antennal segments form-

ing a clasping organ. Apical antennal segment simple, elliptical. Each tibiotarsus of the front legs bears basally on the outer side 4 sense organs, suboblong, thick-walled, and slightly elevated. Claws and mucrones similar to those of the female, although the mucrones are more slender. Length 0.6 mm.

Further study of the types of this species result in the emendation of the original description. The closest relative of this species is *S.* (*Denisiella*) *sexpinnatus* of Costa Rica. The following differences may be noted:

ramosus	*sexpinnatus*
Ant. II (♀) greater than III	Ant. II (♀) less than III
2 pairs of lateral teeth on unguis.	4–5 pairs of lateral teeth on unguis.
A single externo-basal tooth on unguis.	A row of externo-basal teeth on unguis.
Clothing much longer and heavier, longest dorsal bristles longer than the mucro, the longest on the anogenital segment more than half the length of the mucro, longest dental bristle with swollen base half the mucro.	Clothing shorter, longest dorsal bristle 2/3 the mucro, the longest on the anogenital segment less than half the mucro.

Hawaii.

Sminthurides (Denisiella) sexpinnatus Denis

Plate IX, fig. 102

1931, *Sminthurides sexpinnatus* Denis p. 156.

Color largely violaceous. Eyes 8 on either side, 2 in each eyepatch poorly developed. Antennae as long as the head, the segments as 7:9:11:18. Fourth antennal segment not subsegmented. Organ of 3rd antennal segment normal. Crenulate setae of tibiotarsi as in *ramosus* or *seurati;* 1 antero-internal subapical bristle on the 1st pair, 1 similarly placed but weakly crenulate on the 2nd pair, and 5 ranging along the postero-inner face of the 3rd pair. Ungues with 1 inner tooth, 4-5 lateral teeth, and an externobasal series of denticles (figure 102). Unguiculi slender, the filament exceeding the unguis. Tenaculum with the corpus short and rather flat, bearing a pair of anterior bristles; rami tridentate, with basal clavate appendages. Dens 2.6 times the mucro; outer lamella entire or with 1 or 2 obscure teeth, not attaining the apex. Inner lamella with many teeth. Mucronal seta present. Six crenulate seta surrounding the anus. Clothing abundant, the dorsal

abdominal bristles $^2/_3$ the mucronal length; those of the anogenital segment less than half the mucro. Length 1 mm.

This species is closest to *ramosus*. There are differences, as noted under the discussion of that species. However, *sexpinnatus* is known from but 1 female, and the range in variation of structures is unknown.

Costa Rica.

Subgenus Sphaeridia Linnaniemi 1912

Tibiotarsal organs of 3rd pair of legs absent. Mucrones without lamellae, the inner edge toothed; without mucronal bristles, slender, toward the apex not strongly narrowed. Fourth antennal segment simple, not subsegmented. Clasping organs of male antennae simple, the large opposing bristles small, nearly straight, without or with very poorly developed papillae and accessory structures. Bases of bothriotricha nearly in a straight line. Rami of tenaculum reaching beyond apex of corpus, 3-toothed, with a basal club; corpus heavy, normally with 2 anterior bristles and none apically. Anogenital segment broadly attached to body. Size small, rarely reaching 0.5 mm. in the female and 0.3 in the male. Type: *S. Sphaeridia pumilis* (Krausbauer).

Key to the species of Sphaeridia Linnaniemi

1. Antennae shorter than the head, about as 0.88:1 .... *minimus* (Schött) 1893. P. 271
   Antennae longer than the head or subsqual to it, about as 13:10, rarely as 1:1 2
2. Hind tibiotarsae with 2 heavy appressed unilaterally serrate bristles on the antero-mesal face .... *serratus* n. sp. P. 268
   Hind tibiae without these serrate bristles .... *pumilis* (Krausbauer) 1898. P. 270

Sminthurides (Sphaeridia) serratus spec. nov.

Plate IX, figs. 103–107

Brown or reddish brown, lighter along the sutures, with lighter roundish spots on the sides; prothorax light. Antennae brownish purple apically, paler basally. Legs weak bluish brown, furcula dilute brown. Venter lighter. Six eyes visible on either side, possibly 8 present as in other species of the genus. Third antennal segment organ normal. Antennae slightly longer than the head, about as 12:11; the

segments about as 5:8:9:26; 4th segment simple, with several subapical olfactory hairs (figures 103, 104). Ungues and unguiculi similar to *S. pumilis*, the inner tooth of the hind unguis often minute or apparently wanting. Ventral tube with simple vesicles. Corpus of tenaculum shorter than the rami, with 2 anterior bristles; rami tridentate, with basal clavate structures. Dentes less than 2 times the mucrones, about as 13:8, or 34:19; mucrones slender, without lamellae, the inner margin serrate, the outer with a notch at about the middle (figure 106). Mucronal bristle absent. Dorsal segmentation of the body usually visible. Dorsum with slender pointed slightly curving hairs in single rows across the anterior part of the dorsum, and a patch of more numerous long heavy pointed bristles on the posterior dorsum, the longest more than half the length of the mucro, as 19:33; anogenital segment with fewer more slender hairs. Three pairs of bothriotricha on the body, apparently 2 on the 2nd abdominal segment and 1 on the 3rd, their bases nearly in a straight line; anogenital segment with 2 pairs, the anterior longer and situated farther toward the sides than the posterior pair. Each hind tibiotarsus bears on its anterior inner face and near the middle 2 heavy nearly appressed unilaterally serrate bristles (figures 105, 107). Length 0.32 mm.

Males have not thus far been seen.

This species resembles closely *S. pumilis* (Krausbauer), from which it differs in the following respects:

serratus	*pumilis*
Serrate bristles on the hind tibiotarsus.	Such serrate bristles absent.
Subapical hairs on 4th antennal segment short, blunt, and heavy.	Subapical bristles of 4th antennal segment longer and more slender.
Dorsal segmentation usually evident.	Dorsal segments usually obliterated.
Heavy bristles limited to a posterodorsal area.	Heavy bristles extend toward the front with no definite limitation at the middle of the dorsum.

S. (*Sphaeridia*) *serratus* is an inhabitant of leaf mould.

Louisiana, Tallulah, October 12, 1934, J. W. F.

Georgia, Jasper County, September 1, 1936, W. F. Turner.

North Carolina, Asheville, A. P. Jacot.

Missouri, Scott County, September 24, 1936, W. F. Turner, Wm. Anderson, James Graff.

Sminthurides (Sphaeridia) pumilis (Krausbauer)

Plate IX, figs. 108–112

1902, *Sminthurus pumilis* Krausbauer p. 21. 1901, *Sminthurides pumilis* Börner p. 138. 1902, *Sminthurides globosus* Axelson p. 109. 1905, *Sminthurides pumilio* Axelson p. 40. 1912, *Sminthurides* (*Sphaeridia*) *pumilio* Linnaniemi pp. 248–249.

Body high arched. General color typically lighter or darker violet or purple, sometimes reddish or brown, with many pale spots of various forms and sizes. The general color varies from olivaceous to ferruginous. An anterior or posterior dorsal stripe may occur, and often there are wide median dorsal pale areas. Sternum, antennae, legs, and furcula paler violet; 4th antennal segment dark violet.

Female. Eyes 8 on either side, 6 usually plainly visible. Antennae a little longer than the head, rarely subequal to it; measurements of 4 specimens give proportions of 13:10, 87:83, 80:80, 151:134; with segments about as 1:3:2.5:6.5. Fourth antennal segment simple, not subsegmented. Ungues with a pair of small lateral teeth, those of the first 2 pairs of legs rather straight and slender, with a small distal inner tooth on each (figure 108). Ungues of 3rd pair of legs broader (figure 109), curving, with or without an inner tooth on each. Unguiculi of first 2 pairs of legs with a subapical filament which exceeds the unguis. Hind unguiculi broader, lanceolate, with or without a small filament. Tibiotarsal organ of hind legs absent. Tenaculum with tridentate rami, lateral appendages, and a pair of anterior setae (figure 111). Corpus exceeded by the apices of the rami. Dens from $1^3/_4$ to twice the length of the mucro. Mucro long and narrow, without lamellae; inner dorsal margin serrate; outer entire, with or without a tooth before the middle; ventrally obtusely excavated beyond the middle, in lateral aspect (figure 110). Mucronal seta absent. Body setae comparatively long and stiff; sparse anteriorly. Bothriotricha: 3 pairs on the large abdominal segment, 1 pair on the 5th and 1 pair on the 6th; those on the 6th segment are short and subdorsal. Length 0.55 mm.

In one specimen both posterior pairs of bothriotricha were apparently on the 5th segment, the 1st anterolateral and long and the 2nd subdorsal and short.

Male. The male is like the female structurally. Antennal segments as 15:34:21:72. Clasping organ relatively simple (figure 112). In one specimen 4 pairs of bothriotricha were noted on the body. Length 0.23 mm.

Variation. In the material examined, olivaceous and some ferrugin-

ous individuals have purple antennae and legs; other ferruginous specimens have ferruginous antennae (excepting the 4th segment which is always dark purple), legs and furcula. The furcula may be pigmented or not and the legs vary in their pigmentation, which may be lighter or darker, or sometimes spotted.

Denis (1933, p. 273) says that it is practically impossible to recognize the sex of young forms. They are pale, with only 6 of the 8 eyes pigmented, and without bothriotricha on the body (though they are present on the anogenital segment). In addition the first 4 abdominal segments are strongly reduced as in *Megalothorax*.

North America: Iowa, Louisiana, Utah, Manitoba (Churchill).

Costa Rica, Norway, Germany, Finland, Switzerland, Hungary, Poland, Czechoslovakia, Australia.

SMINTHURIDES (SPHAERIDIA) MINIMUS (Schött)

1893, *Sminthurus minimus* Schött p. 7. 1927, *S. Sph. m.* Schött p. 33.

Clear blue, stripes and points showing through the ground color. One male possessed a rectangular whitish stripe on the anterior dorsum. Head to the antennae as 1:0.88, the 4 segments as 1:1.66:1.5:4.17. Fourth antennal segment simple. Organ of 3rd antennal segment composed of 2 rods sunk in a cuticular groove. Ungues with an inner tooth near the middle, the first 2 pairs longer and more slender than the 3rd. First 2 pairs of unguiculi scarcely lamellate, slender; filament attaining the apex of the unguis. Unguiculi of hind legs comparatively broad, lanceolate; without or perhaps with a very weak subapical filament. Sense organs of 3rd tibiotarsi absent. Dentes swollen, bladderlike above, sparsely hairy. Mucrones gradually narrowing distally, ventrally weakly constricted at about the middle, with the inner margin serrate. Short sparse hairs on the head and anterior third of the dorsum, behind this fine needle-like hairs are present on the back. Two pairs of bothriotricha on the 4th abdominal segment (one specimen possessed 4 pairs), 1 pair on the anogenital segment. Fifth and 6th segments confluent. Length of male 0.5 mm, of female 0.3 mm.

Cameroons, West Africa; Kiev, Russia (?).

Schött (1927, p. 34) states that this species may be identical with *pumilis*. Comparative studies will be necessary to establish this fact.

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EXPLANATION OF PLATES

PLATE 1

PLATE 1

S. (Sminthurides) cruciatus Axelson

1. Head. (After Linnaniemi).

S. (Sminthurides) hospes Börner

2. Front foot. (After Börner).

S. (Sminthurides) stagnalis Womersley

3. Tibiotarsal organ of male, (After Womersley).
4. Apex of abdomen of male. (After Womersley).

S. (Sminthurides) globocerus nobis

5. Right tibiotarsal organ.
6. Left antenna of female.
7. Left mucro.
8. Right hind foot.

S. (Sminthurides) aquaticus (Bourlet)

9. Left eye (Illinois).
10. Tenaculum. (Illinois).
11. Tibiotarsal organ. (Illinois).
12. Left mucro. (Massachusetts).
13. Left hind foot. (Illinois).

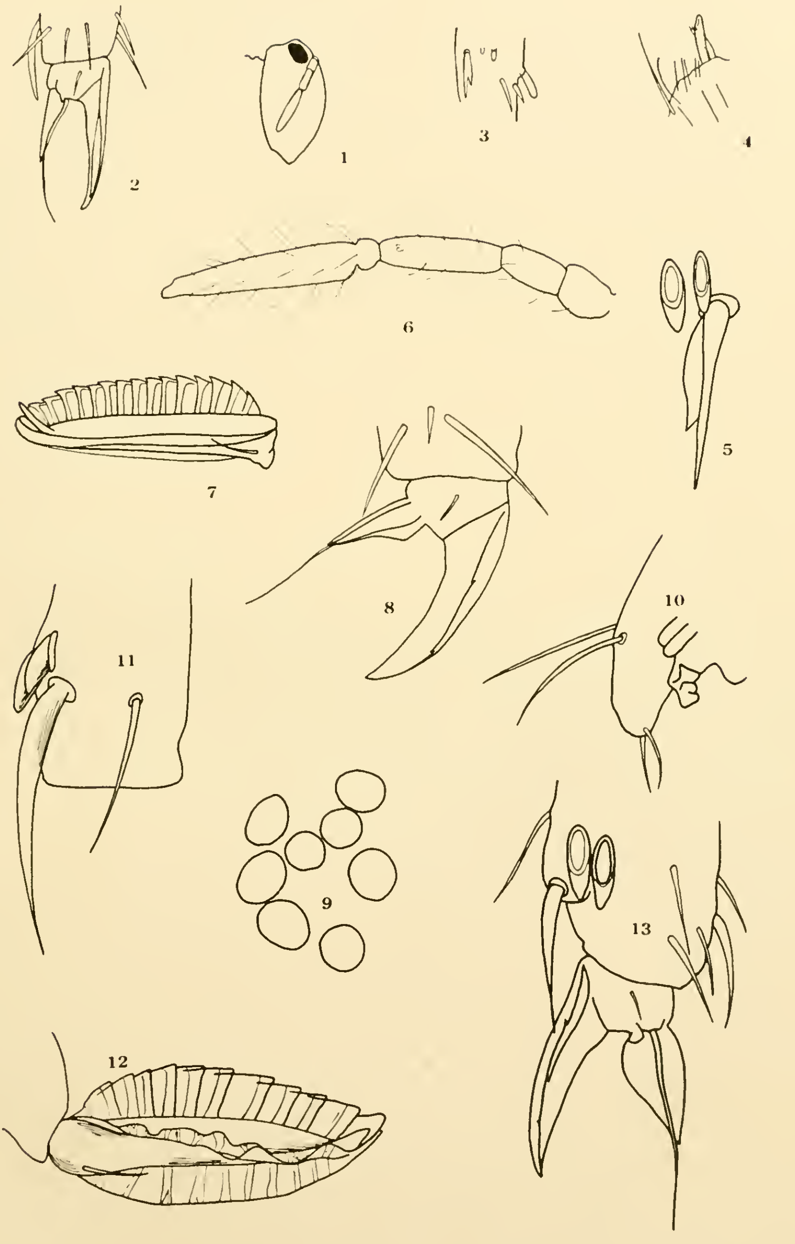
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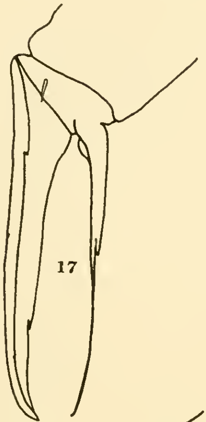
PLATE 2

PLATE 2

S. (*Sminthurides*) *aquaticus* (Bourlet)

14. Right middle foot. (Illinois).
15. Left fore foot. (Finland).
16. Right hind foot. (England).
17. Left fore foot. (Germany).
18. Left fore foot. (England).
19. Lateral view. (Poland).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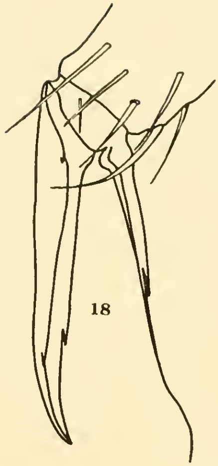
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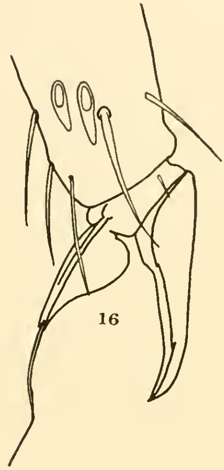
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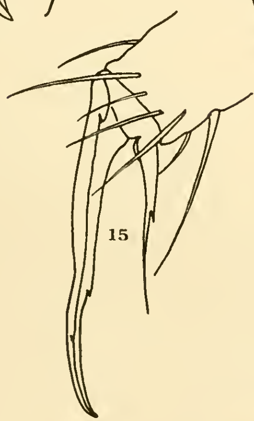
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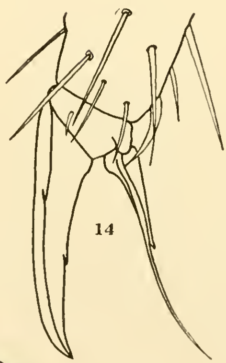
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PLATE 3

PLATE 3

S. (*Sminthurides*) *ludovicianus* nobis

20. Left fore foot.
21. Right middle foot.
22. Left hind foot.
23. Tibiotarsal organ.
24. Tenaculum.
25. Ventral tube.
26. Right mucro.
27. Left mucro.

S. (*Sminthurides*) *malmgreni* (Tullberg)

28. Tibiotarsal organ.
29. Tibiotarsal organ. (Var. *palustris* nobis)
30. Left mucro, dorsal view.
31. Tenaculum.

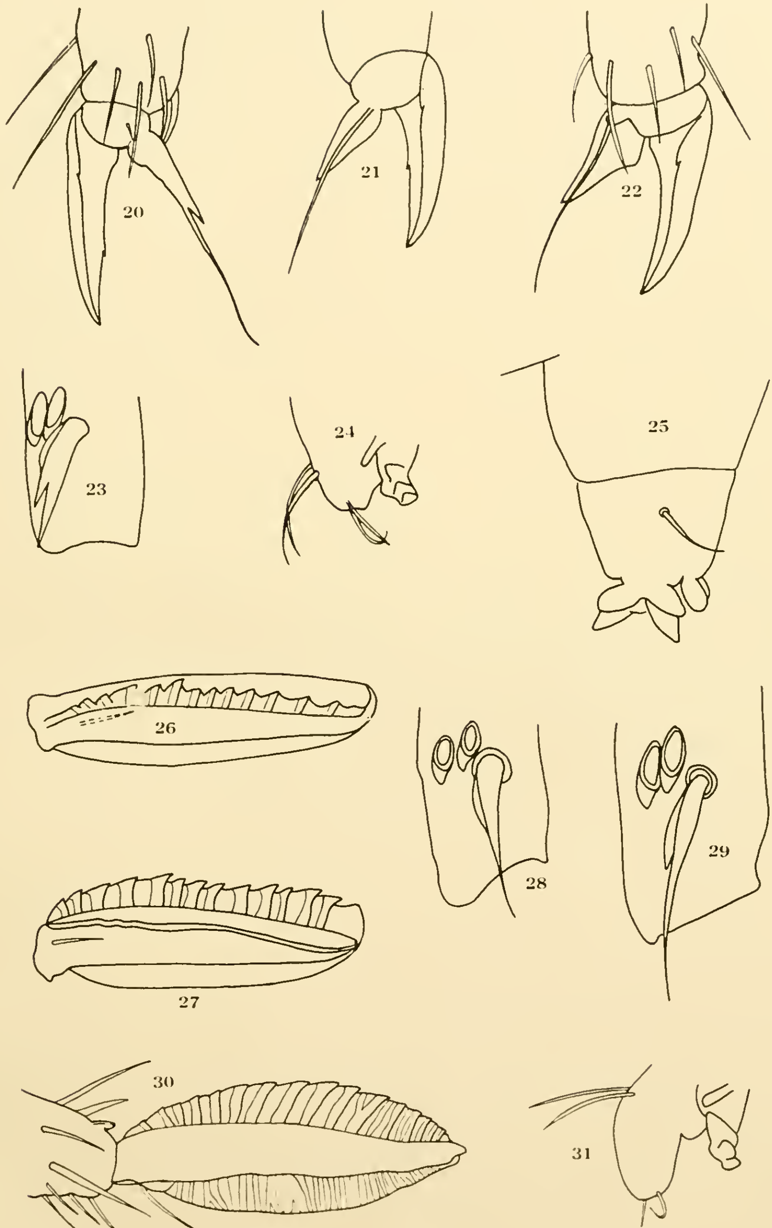
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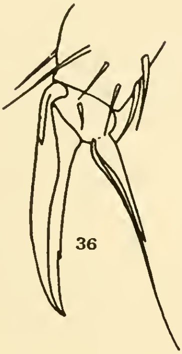
PLATE 4

PLATE 4

S. (*Sminthurides*) *malmgreni* (Tullberg)

32. Left mucro.
33. Left middle foot. (Finland).
34. Back of right hind foot. (Finland).
35. Left hind foot. (Finland).
36. Right fore foot. (U.S.A.).
37. Lateral view. (Var. *palustris* nobis)
38. Lateral view. (Var. *elegantulus* (Reuter); Poland).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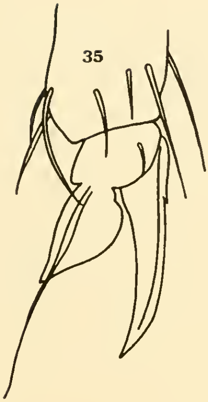
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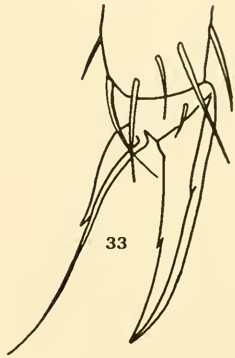
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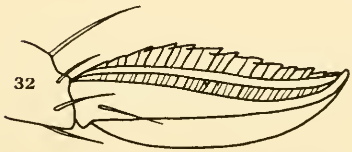
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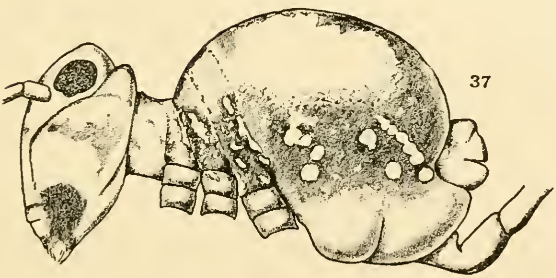
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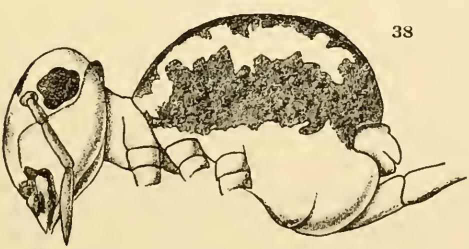
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PLATE 5

PLATE 5

S. (Sminthurides) spegazzinii Börner

39. Front foot. (After Börner).

S. (Sminthurides) appendiculatus Imms

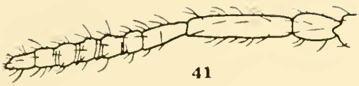
40. Hind foot. (After Imms).

S. (Sminthurides) melanotus Börner

41. Antenna. (After Börner).

S. (Sminthurides) bifidus Mills

42. Right eyes.
43. Tenaculum.
44. Right fore foot.
45. Right hind foot.
46. Fourth antennal segment of female.
47. Left mucro of male, dorsal view.
48. Left mucro of female, dorsal view.



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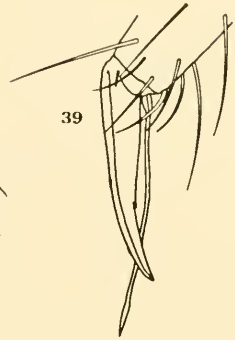

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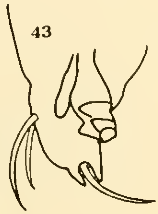

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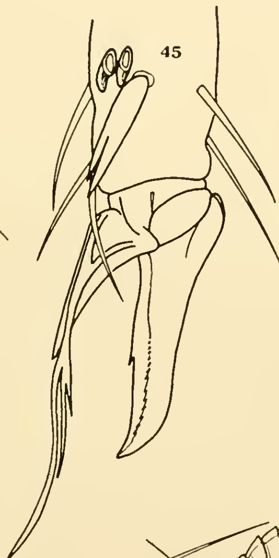

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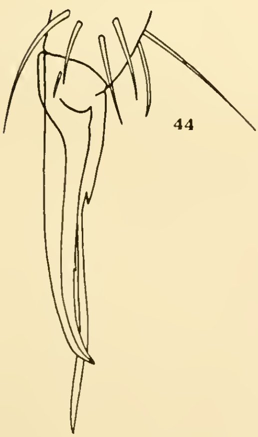

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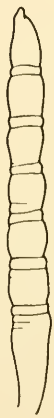

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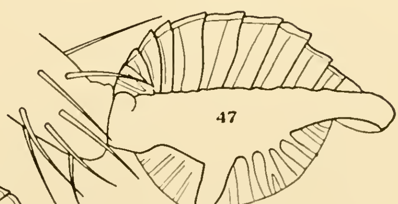

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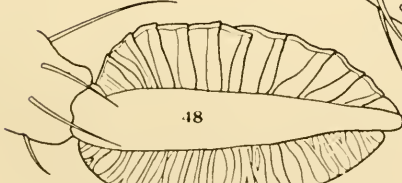

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PLATE 6

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S. (Sminthurides) penicillifer (Schäffer)

49. Hind foot. (After Börner).

S. (Sminthurides) schötti Axelson

50. Left mucro. (Czechoslovakia).
51. Tibiotarsal organ. (Czechoslovakia).
52. Fourth antennal segment of female. (Czechoslovakia).

S. (Sminthurides) parvulus (Krausbauer)

53. Lateral view of mucro. (After Krausbauer).
54. Ventral view of mucro. (After Krausbauer).

S. (Sminthurides) assimilis (Krausbauer)

55. Fourth antennal segment of female.
56. Right fore foot.
57. Right hind foot.
58. Left mucro.

59–61. Dorsal color patterns.

S. (Sminthurides) krausbaueri distinctus Linnaniemi

62. Left hind foot.
63. Tibiotarsal organ.
64. Right mucro.
65. Fourth antennal segment of female.

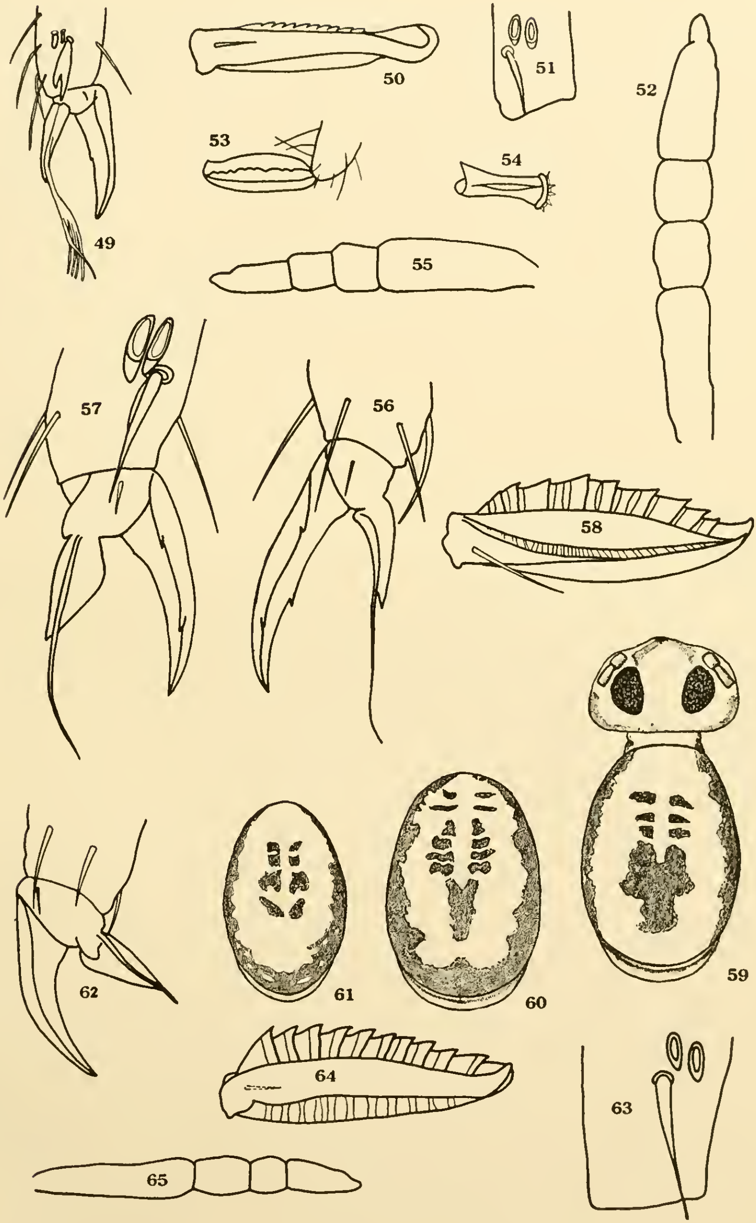
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PLATE 7

PLATE 7

S. (*Sminthurides*) *annulicornis* Axelson

66. Left hind foot.
67. Right fore foot.
68. Apex of ventral tube.
69. Left mucro.
70. Fourth antennal segment of female, moulting specimen.

S. (*Sminthurides*) *macnamarai* nobis

71. Right fore foot.
72. Inner face of middle unguis.
73. Fourth antennal segment of female.
74. Right mucro.
75. Dorsal view of right mucro.
76. Left mucro.

S. (*Sminthurides*) *occultus* Mills

77. Anterior view of ventral tube.
78. Right mucro.
79. Fourth antennal segment of female.
80. Right hind foot.
81. Dorsal color pattern.

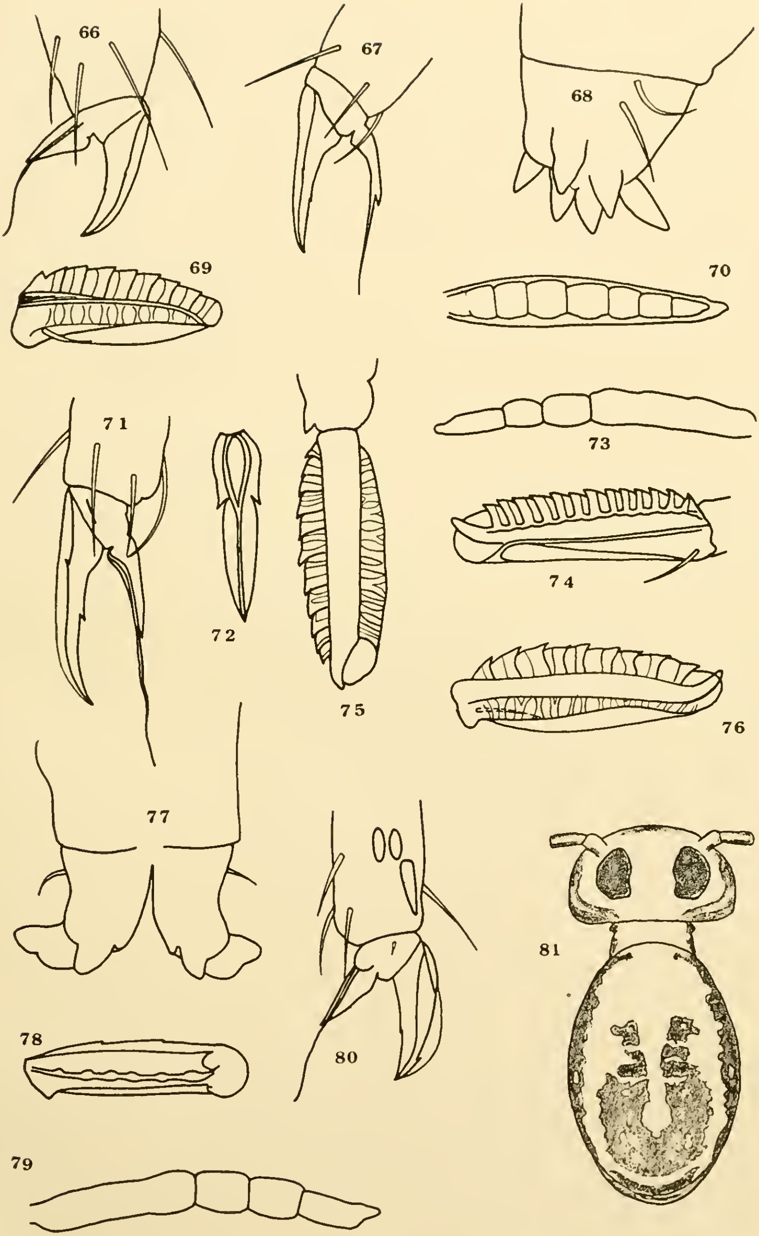
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PLATE 8

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S. (*Sminthurides*) *lepus* Mills

82. Tenaculum.
83. Right mucro.
84. Lateral view. (After Mills).
85. Tibiotarsal organ.
86. Right fore foot.
87. Fourth antennal segment of female.

S. (*Sminthurides*) *plicatus* (Schött)

88. Dorsal view of mucro. (After Schött.)

S. (*Stenacidia*) *violaceus* (Reuter)

89. Mucro. (After Krausbauer.)

S. (*Denisiella*) *serrosetosa* Börner

90. Antennae of female. (After Börner.)
91. Foot. (After Börner.)

S. (*Denisiella*) *seurati* Denis

92. Right hind foot. (After Denis.)
93. Tenaculum. (After Denis.

S. (*Denisiella*) *ramosus* Folsom

94. Right hind tibiotarsus.
95. Crenulate spine from right front tibiotarsus.
96. Crenulate spine from left middle tibiotarsus.
97. Right hind foot.
98. Inner face of middle unguis.
99. Tenaculum.
100. Left mucro.
101. Dorsal view of right mucro.


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PLATE 9

PLATE 9

S. (Denisiella) sexpinnatus Denis

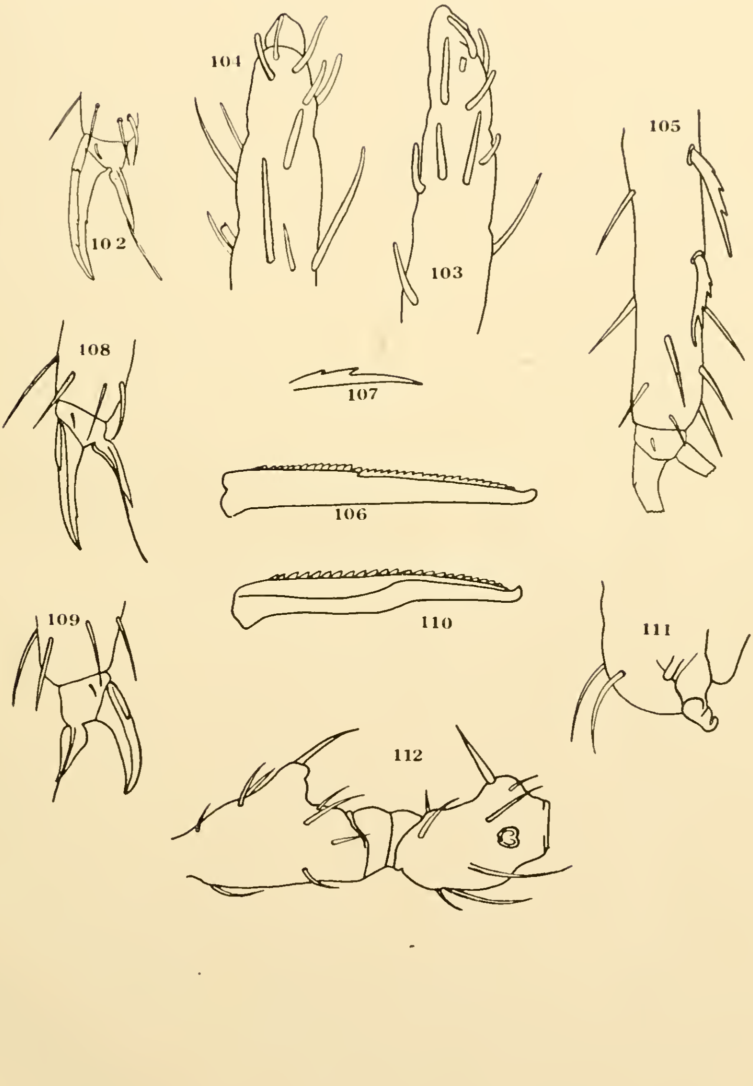
102. Hind foot. (After Denis.)

S. (Sphaeridia) serratus nobis

103. Apex of left antenna.
104. Apex of right antenna.
105. Apex of left hind tibiotarsus.
106. Left mucro.
107. Serrate seta of hind tibiotarsus.

S. (Sphaeridia) pumilis (Krausbauer)

108. Left fore foot.
109. Left hind foot.
110. Left mucro.
111. Tenaculum.
112. Clasping organ of male antenna.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THE FULGORINA OF BARRO COLORADO AND OTHER PARTS OF PANAMA

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With Twenty-three Plates

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No. 5.—*The Fulgorina of Barro Colorado and Other Parts of Panama*

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In the summer of 1924 Mr. Nathan Banks, Curator of Insects of the Museum of Comparative Zoölogy of Harvard University spent some time collecting insects on Barro Colorado Island, Gatun Lake, Canal Zone. Among these was a large number of Fulgorids. These he turned over to me for study. At about the same time Mr. C. H. Curran, Assistant Curator of Insect Life of the American Museum of Natural History called my attention to a number of Fulgorids in their collections from Barro Colorado. Still later Mr. Paul Oman, Curator of Homoptera of the United States National Museum, separated the material in their collections from Barro Colorado and sent it to me for study. These three collections together with a considerable collection which I have from Central and South America formed the nucleus for a report which would supplement the reports of Distant and Fowler in the Biologia. I suggested this to Mr. Banks and he agreed to its publication.

CLASSIFICATION USED

In the present report I have used the general classification developed recently by Muir (1930c) and have supplemented this general classification with special works in more restricted groups especially the work of Melichar, Muir, Schmidt and Jacobi. I have tried as far as possible to identify the species included in the Biologia. I have, also, attempted in so far as material would permit to rehabilitate the genera established by Stål, and to modernize the descriptions. Whether I have been even partially successful in this, time alone can tell. Stål's descriptions and keys are concise, but are mostly without illustrations and whether we have always correctly translated and interpreted these descriptions is still another matter. The general illustrations in the Biologia are wonderful but the details and descriptions leave much to be desired. Color alone is not a very trustworthy taxonomic character, but I have done the best I could with the material available. This amounts almost to a revision of certain families like the Achilidae and Fulgoridae, where very little work has been done recently, and the new material has necessitated considerable revision in other families and especially in certain genera.

GENOTYPES

Again I have attempted to settle certain genotypes with the aid of the literature available. Certain matters in nomenclature can be settled by rule if we have all the facts before us. I have devoted more than twenty-five years to collecting and collating the literature dealing with the Homoptera. These years have taught me that it is practically impossible to collect and catalogue completely the literature dealing with even a small group of insects. However, I have developed a card catalogue of all the literature known to me. This now consists of about three-quarters of a million items. With it as a basis I have attempted to settle some controversial questions. Some of the dispositions I have made will require considerable readjustment of names, but not nearly as much as will be required eventually if present errors are perpetuated. None of the genotypes have been selected without the most painstaking care. However, I suffer from no delusions that I may have avoided all mistakes. In nomenclatorial work that seems to be practically impossible.

KEYS

I have introduced copious keys to subfamilies, tribes, genera and species, in an attempt to include as far as possible the forms that are known from Central America and contiguous areas. These keys have been used repeatedly on a large amount of material from the Americas. I have exhausted every effort to make them as clear cut and concise as possible. However, after all care is taken, the use of a key is largely a matter of interpretation. The worker must use all diligence in attempting to get the meaning which all language conveys so imperfectly.

ILLUSTRATIONS

The limitation of language has induced the author to use illustrations in all his taxonomic work. Illustrations, even those made with the utmost care, have their limitations. It is not possible to convey accurate ideas of tridimensional objects by means of flat drawings especially line drawings. But with all these limitations, carefully made illustrations tell more than many pages of printed matter, and for that reason I have used them extensively.

I am indebted to Mrs. Elizabeth Haben Kaston and Mr. George Horton for their painstaking efforts in this direction. Mrs. Kaston made most of the wash drawings and some of the outline drawings.

Mr. Horton made most of the outline drawings and has been especially industrious in working out the details of the complicated genitalia.

GENITALIA

The present study further confirms the writer's belief that the genitalia, especially the male genitalia, furnish the most reliable taxonomic and systematic characters. Eventually, I believe, that the phallic characters will take rank equal to, if not ahead of, chrotic characters in determining the taxonomic and systematic status of the Homoptera.

Fieber (1866b) was the first, I believe, to call attention to the value of the male genitalia in separating the various species of the family ARAEOPIDÆ (Delphacidæ). Much later Kirkaldy mentions the value of these characters for generic purposes, but apparently abandons the idea when he becomes involved in what he calls the "Delphax complex." Still later Muir lays great stress upon the value of phallic characters in establishing his classification of the families of the Fulgorids.

In the Fulgorina we have a group of primary species in which phallic characters have been developed to a high degree, while chrotic characters are not evident. In part this is due to the small size of the species and in part to the variable nature of the more obvious characters, such as arrangement of carinæ on the head and thorax, the comparative length and breadth of the forehead and crown and of the antennal segments and the tibial spines.

The placing of a species in the proper genus is, therefore, a task requiring the widest possible acquaintance with the genera of the world, a broad and comprehensive grasp of the extreme limits of these variable characters and the ability to assign true values to the characters from various regions of the body. The size of this task becomes apparent when we realize that there are 1217 known genera and 6521 species in the world. These insects have been collected and studied intensively only for Europe, North America north of Mexico, and the Hawaiian Islands. Rather extensive collecting has been done in portions of Central America, Cuba, South America, some of the South Pacific Islands, India and South Africa, while great areas of the world remain practically unexplored. We know perhaps one-third of the World fauna in this large group. Hence the necessity of laying as firm a foundation as possible. Any contribution, therefore, which will aid students in placing nearly related forms in the same genus is worthy of consideration. The necessity for proper care in placing species in the

correct genus is further emphasized when we observe that our present list shows 120 genera and 1050 species in synonymy in the family ARAEOPIDÆ. A part of this generic synonymy is *homosynonymy,* that is, two or more genera established for the same species. But a large part of it is *heterosynonymy,* that is, two or more genera established for species which subsequent writers believe should be placed in the same genus. Some of this *heterosynonymy* is true synonymy but much of it is false. While the unnecessary multiplication of genera and species has been much ridiculed, very little has been said about the reverse process, the unnecessary reduction to synonymy of valid genera and species. For example, a well known North American species of Fulgorina was selected recently as the type of a new genus. This genus was reduced subsequently to synonymy, being placed in a polyphyletic genus. Unfortunately, the polyphyletic genus in which it was placed belongs to a different subfamily. In the same way many of the genera in ARAEOPIDÆ proposed by Fieber in 1866 were subsequently reduced to synonymy by European workers only to be belatedly revived by Muir in 1915. Three hundred and twenty-nine of the specific synonyms noted above occur in the genus *Liburnia* Stål and three hundred and sixty-eight in the genus *Araeopus* Spinola (*Delphax* Fabricius) due to a process which we might call dumping. In the past, species with indefinite or obscure characters have been dumped first into *Delphax,* then into *Liburnia.* At the present time many species are dumped into *Delphacodes* Fieber, which contains two hundred and eighty-seven species. I have no more notion that this represents the final resting place of all of these two hundred and eighty-seven species than that the genus *Cicada* proposed by Linnaeus in 1758 represented the real classification of the forty-two species proposed at that time and which we place today in the families *sensus strictus* Fulgoridæ, Membracidæ, Cicadidæ, Cercopidæ, Cixiidæ, Flatidæ and Cicadellidæ.

TERMS USED

Most of the terms used are standard and have been used for many years. Throughout the present paper I have used the term crown instead of vertex to refer to the dorsal part of the head between the eyes. I have also used the term forehead to refer to that area of the head usually referred to as frons.

I propose to use these terms for these areas until the true morphological relations of the Homopterous head can be worked out.

Key to the Families of the FULGOROIDEA

(Modified from Muir)

A. Antennal flagellum segmented. Lateral ocelli not outside the lateral carinæ of forehead .... TETTIGOMETRIDÆ

AA. Antennal flagellum not segmented. Lateral ocelli outside the lateral carinæ of forehead, generally beneath the eyes.

- B. Second tarsi of hind leg not very small, the apex with a row of small spines, truncate or emarginate. Without a costal area or with only a small one without cross-veins.
  - C. One or both claval veins granulate, the apical joint of labium much longer than wide. The abdomen laterally compressed; the sixth, seventh, and eighth abdominal tergites bearing wax-secreting pores .... MEENOPLIDÆ
  - CC. Claval veins not granulate, or, if so, then the apical segment of labium short, as wide as long *1*
    1. The sixth, seventh, and eighth abdominal tergites bearing wax-secreting pores .... KINNARIDÆ
    1. The sixth, seventh, and eighth abdominal tergites not bearing wax-pores *2*
    2. Anal area of hind wings reticulate, many cross-veins FULGORIDÆ
    2. Anal area of hind wing not reticulate *3*
    3. Apical segment of labium short, about as wide as long DERBIDÆ
    3. Apical segment of labium long, distinctly longer than wide *4*
    4. Claval vein entering the apex of clavus *5*
    4. Claval veins not reaching to the apex of clavus, entering commissure before apex *6*
    5. Base of abdomen with one or two short appendages bearing depressions. Laterally compressed forms; tegminae tectiform, the membrane not overlapping.... ACHILIXIIDÆ
    5. Base of abdomen without such developments. Mostly horizontally flattened forms; the membranes beyond clavus overlapping .... ACHILIDÆ
    6. Hind tibia with a mobile spur at the apex .. ARAEOPIDÆ
    6. Hind tibia without a mobile spur *7*
    7. Head prolonged in front, sometimes greatly so, or if not, then forehead with two or three carinæ, or the tegulæ absent and claval suture obscure. Always without median ocellus .... DICTYOPHARIDÆ
    7. Head not prolonged in front or only moderately so, the forehead with only a median carina or none, excluding

lateral margin. Tegulae present and claval suture distinct. The median ocellus often present............CIXIIDÆ

BB. Second hind tarsi small or very small, the apex without spines or with only one at each side; the apex generally rounded or pointed. Costal area absent or present.

C. Second hind tarsus with a spine on each side, the apex rounded or bluntly pointed. Claval vein nearly always ending in apex of clavus.......................................*1*

1. The posterior angle of mesonotum restricted off by a groove or fine line................TROPIDUCHIDÆ

1. Posterior angle of mesonotum not so restricted off. Hind basitarsus generally short or very short..............*2*

2. With a cross-veined costal area, but without granules on clavus and nearly always with lateral carinae on clypeus NOGODINIDÆ

2. Without a cross-veined costal area, or, if with such, then the clavus granulate or the clypeus without lateral carinæ.......................................*3*

3. With a cross-veined costal area and the clavus granulate or the base of costa strongly curved...........FLATIDÆ

3. Clavus not granulate and base of costa not strongly curved...*4*

4. Tegminæ large, steeply tectiform; hind tibiæ without spines on the sides; no costal area....ACANALONIIDÆ

4. Tegminæ not so large and generally not so steeply tectiform; hind tibiae generally with one or more spines on the side. Pronotum short, especially behind the eyes. Costal area generally absent or obscure...............ISSIDÆ

CC. Second hind tarsus small, with the apex rounded or bluntly pointed, without any spines.........................*1*

1. Tegminæ wide on apical margin, steeply tectiform, with a cross-veined costal area; clavus long. Head as wide, or nearly as wide, as the thorax. Hind basitarsus short or fairly short............................RICANIIDÆ

1. Tegminæ not so wide on apical margin nor so steeply tectiform, or the head is distinctly narrower than thorax; clavus not so long.................................*2*

2. Forehead seldom so wide as long and often with the lateral margins not angular, nearly always with one to three longitudinal carinæ, and the clypeus generally having lateral carinæ.........................LOPHOPIDÆ

2. Forehead wider than long, sides angular; no lateral carinæ on clypeus and no longitudinal carinæ on forehead or only a very obscure one.............EURYBRACHYDIDÆ

Family CIXIIDAE

The head in this family is usually not much modified; the forehead is large and the clypeus relatively small; the third or median ocellus is usually present; the antennae are usually small with the first segment short, more or less concealed by the larger globose second segment; the pronotum is usually short; the mesonotum large, tegulae present; tegminae usually transparent or translucent, nodal cell conspicuous; legs slender, hind tibiae with or without lateral spines; ovipositor complete or incomplete in which case the pygofer is broad and flat.

Key to the American Genera of CIXIIDAE

(Modified from Muir)

A. Antennae in front of eyes, sunk into pits; with a distinct subantennal process. (Subfamily BOTHRIOCERINÆ) . . . . *Bothriocera* Burm.

AA. Antennae below eyes, not sunk into pits; no subantennal process. (Subfamily CIXIINÆ).

- B. Fourth and fifth abdominal segments with abdominal processes. (Tribe BENNINI) . . . . *Bennarella* Muir 1930b: 12
- BB. Abdominal segments without processes.
  - C. Ovipositor complete, female pygofer robust. Body compressed; tegminæ steeply tectiform. (Tribe PINTALIINI) *1*
    - 1. Tegminæ opaque . . . . *Cubana* Uhler 1895a: 62
    - 1. Tegminæ transparent . . . . *Pintalia* Stål
  - CC. Ovipositor incomplete, female pygofer flat often with waxy filaments. Body not greatly compressed, tegminæ usually not steeply tectiform. (Tribe CIXIINI) *1*
    - 1. Media arising from basal cell or from base of subcostal-radial stalk but not forming a common stalk with them. (Subtribe CIXIINA) *2*
    - 1. Media arising from the subcostal-radial stalk. (Subtribe MYNDINA *8*
    - 2. First medial sector long, second medial sector very short . . . . *Mnemosyne* Stål 1866a: 150
    - 2. First medial sector only as long as or shorter than second medial sector *3*
    - 3. Mesonotum with five carinæ *4*
    - 3. With never more than three carinæ on the mesonotum . . *5*
    - 4. Two transverse carinæ between crown and forehead often forming apical fovæ . . . . *Oliarus* Stål
    - 4. Only a single transverse carina between crown and forehead . . . . *Hyalesthes* Signoret 1865a: 128

5. Never more than one carina between crown and forehead *6*
5. With two transverse carinæ between crown and forehead . . . . *Cixius* Latreille 1804a: 310
6. Crown much wider than long *7*
6. Crown longer than wide . . . . *Muirolonia* Metcalf
7. Forehead concave, with a median frontal carina . . . . *Bothriocerodes* Fowler 1904a: 84
7. Basal half of forehead convex, apical half concave, no median frontal carina . . . . *Sevia* Stål 1866a: 81
8. Mesonotum with five carinæ; crown trough-like . . . . *Oecleus* Stål
8. Mesonotum with three carinæ *9*
9. Body compressed, tegminæ steeply tectiform . . . . *Southia* Kirkaldy 1904c: 279 (*Paulia* Stål 1869a: 94)
9. Body not compressed, tegminæ not steeply tectiform . . *10*
10. Crown produced in front of eyes as long as pro- and mesonotum together *11*
10. Crown not greatly produced, shorter than pro- and mesonotum together *12*
11. Forehead with a median longitudinal carina . . . . *Antillixius* Myers 1928i: 16
11. Forehead without a median longitudinal carina . . . . *Rhamphixius* Fowler 1904a: 81
12. Forehead broader than long *13*
12. Forehead longer than broad *14*
13. Crown short, transverse, about four times as broad as long . . . . *Monorachis* Uhler 1901a: 509
13. Crown more elongate about one and one-half times as broad as long . . . . *Microledrida* Fowler 1904b: 99
14. With a median frontal carina *15*
14. Without a median frontal carina *16*
15. With two transverse carinæ between crown and forehead. *Myndus* Stål 1862a: 307
15. With a single carina between crown and forehead . . . . *Nymphocixia* Van Duzee 1923a: 189
16. Crown broader than long . . *Pachyntheisa* Fowler 1904b: 99
16. Crown longer than broad *17*
17. Crown with a median carina . . . . *Platycixius* Van Duzee 1914a: 37
17. Crown without a median carina . . . . *Micrixia* Fowler 1904b: 100

Subfamily BOTHRIOCERINÆ

In this subfamily the head is much modified, the antennæ are sunk in pits or are provided with subantennal processes or ledges which are sometimes laminate and strongly produced.

Tribe BOTHRIOCERINI

In this tribe the head is peculiarly twisted, the ventral sinus of the compound eyes is directed more or less anteriorly and the antennae lie in distinct pits anterior to the sinuses; the tegminæ are broad and the first cubital sector is deeply forked; the ovipositor is complete.

There is but a single known genus in this tribe with numerous species from North, Central and South America and the West Indies.

Bothriocera Burm.

(Burmeister 1835a: 156)

Haplotype *Bothriocera tinealis* Burmeister.

This very distinct genus may be recognized readily by the peculiar twisted head with the antennae anterior to the eyes instead of ventral to them. The antennae are also sunk into pits. The crown is short. The pronotum very short. The tegulæ and mesonotum are very large, the latter being tricarinate. The tegminæ are rather broad. Sc and R are united for some distance; there is a distinct stigmatal area; R is three-branched and M five-branched; cubital sector is deeply forked.

About a dozen species have been described from North, Central and South America. An examination of drawings of the types of *bicornis* Fabricius and *undata* Fabricius would indicate that there is considerable confusion in the various species. The species called *venosa* by Fowler (1904a: Plate IX, Figs. 14, 14a) is apparently *undata* Fabricius; *bicornis* Metcalf (1923a: 162; Plate 44, Fig. 84) is apparently *signoreti* Stål; *tincalis westwoodi* of Fowler (1904a: 82; Plate IX, Fig. 12) seems to be *westwoodi* Stål a valid species. *Signoreti* as identified by Fowler and Metcalf seems to be correct. *Undata* as identified by Metcalf seems to be correct. *Drakei* Metcalf, including *tincalis floridana* Dozier and *bicornis* Dozier seems to be a good species, as well as the following species described by Fowler: *albidipennis, excelsa* and *nigra*.

I have not seen males of all the species but the following key based on color of tegminae is suggested as a means of stabilizing our nomen-

clature until the structural characters and especially the male genitalia may be correlated with the color characters.

Key to the Species of BOTHRIOCERA *Burmeister*

A. Tegminæ heavily marked with fuscous or black, often with pale or transparent spots.
  B. Tegminæ with conspicuous transparent spots.
    C. Clavus heavily marked with fuscous *1*
      1. With fuscous spots in the transparent apical cells *2*
      1. Apical cells not marked with a regular row of fuscous spots *6*
      2. With a single row of fuscous spots in the apical cells *3*
      2. With two rows of fuscous spots in the apical cells .... *parvula* Fabricius 1798a: 521 (Stål 1869a: 93) (Brazil)
      3. Transparent pale spot on the base of tegminæ remote from the costal border .... *tinealis* Burmeister (Brazil, Central America, West Indies, Southern United States)
      3. Basal transparent spot reaching costal margin *4*
      4. Basal costal spot narrowed to costal margin .... *bicornis* Fabricius (Southern United States to Brazil)
      4. Basal costal spot not narrowed to the costal margin *5*
      5. Clavus entirely fuscous, tegminæ largely fuscous, basal spot and apical border transparent .... *basalis* Metcalf (Central America)
      5. Clavus largely transparent, tegminæ largely transparent *westwoodi* Stål (Southern United States, Mexico, Central America)
      6. Clavus entirely fuscous .... *signoreti* Stål 1864a: 50
      6. Clavus marked with transparent and fuscous .... *excelsa* Fowler 1904a: 83 (Mexico)
    CC. Clavus transparent, not heavily marked with fuscous....... *drakei* Metcalf 1923a: 179 (Florida)
  BB. Entire tegminæ black or fuscous .*nigra* Fowler 1904a: 84 (Mexico)

AA. Tegminæ transparent or very sparsely marked with fuscous.
  B. With an irregular fuscous fascia from stigmatal spot to apex of clavus .... *undata* Fabricius 1803a:101 (Stål 1869a: 93) (Southern States, West Indies)
  BB. Tegminæ not transversely banded.
    C. Median tooth of male pygofer triangular, acute .... *albidipennis* Fowler (Mexico)
    CC. Median tooth of male pygofer short, blunt .... *pellucida* Fowler (Mexico)

BOTHRIOCERA BICORNIS Fab.

Plates XV, XVII

Fabricius 1803a: 101, Stål 1869a: 93.

This species may be distinguished from other species known to me by the fuscous tegminae with clavus almost entirely fuscous; the base of the corium irregularly spotted with pale testaceous, typically there is a small spot at the extreme base; a large irregular spot on the basal area extending from costal margin to claval suture, this spot narrows abruptly to the costal margin and widens out toward the claval suture; a short narrow diagonal streak at middle of costal margin; and internal to this streak there is a very small pale spot; the apex of the wing is pale with the veins narrowly fuscous and a regular row of fuscous submarginal spots.

The genitalia are quite distinct; the genital styles are robust widely separated basad, contiguous apically, with the apical margin oblique and sinuate, viewed laterally the dorsal apical margin is strongly produced forming elongate obtuse angles; the aedeagus is complex and the flagellum is elongate tubular.

In the present collection there is a considerable series from Barro Colorado, July and August 1924, N. B. and July 1929, C. H. C.

BOTHRIOCERA ALBIDIPENNIS Fowl.

Fowler 1904a: 84.

There is a single female specimen from Mount Hope, Canal Zone, that I place here. Although it is paler than typical *albidipennis* with the mesonotum and abdomen orange testaceous instead of black, the tegminæ do not overlap as much as Fowler indicates for his species. The head, however, is broad and bears the typical markings of *albidipennis* and until the male genitalia can be examined it may be placed here.

BOTHRIOCERA PELLUCIDA Fowl.

Fowler 1904a: 83.

There is a single female specimen from Barro Colorado, July 24, N. B. which seems to agree more closely with this species than any other. The tegminae are largely translucent with a large stigmatal spot and the clavus fairly heavily marked with fuscous.

Bothriocera tinealis Burm.

Plate XVII

Burmeister 1835a: 156.

I cannot be sure of this species as Burmeister's description is brief and does not quite agree with Fowler's illustration. There is, however, a single male from Barro Colorado, 20 July 1924, N. B., which resembles Fowler's illustration somewhat and more nearly fits Burmeister's description. The coloration of the tegminae resembles *bicornis* with the following differences: the transparent spot on the basal area is remote from the costal margin and invades the clavus; the subapical fuscous area has three distinct nearly circular transparent spots. These differences in color could not be considered specific if they were not coupled with very marked differences in genitalia. The genital styles are elongate, slender at the base broadly expanded apically and contiguous on their median margins for more than half their length; extending beyond apex of pygofer when viewed laterally they are short robust with the dorsal margin truncate. The aedeagus is relatively simple and the flagellum is serrate. The anal segment is strongly produced ventrally.

Bothriocera westwoodi Stål

Plate XVII

Stål 1856b: 163.

I am not sure whether I have correctly identified this species or not. Stål's description is brief and Fowler's illustration does not agree in all respects. However, there are three specimens in the present collection, Canal Zone, Mt. Hope, 8 July 1924, N. B., which agree closely enough. And in order to avoid further confusion I have decided to use this name for these specimens until the types can be studied. In general the tegminae have the same picture as found in *bicornis* and *tinealis*, the transparent areas are larger, the boundaries between the transparent areas and fuscous areas are much less definite, the subapical row of fuscous spots is somewhat large and less definite but not as much so as shown in Fowler's figure. The genitalia, however, are entirely different. The pygofer is short and robust. The genital styles are robust with the apices suddenly bent dorsad and ending in an obtuse tooth.

BOTHRIOCERA BASALIS spec. nov.

Plates XV, XVII

This species belongs to what I call the *bicornis-tinealis-westwoodi* group of species with a large basal transparent spot and with the apical area transparent with a single row of fuscous dots in the cells.

The crown, forehead, and legs are testaceous yellow. The pro- and mesonotum are blackish fuscous. The tegminae are largely fuscous. There is a large basal transparent spot which extends from the costal margin to the claval suture and apically almost to the nodal cell. There is a small elongate spot on the costal margin beyond the nodal cell and the apical margin is broadly transparent. The fuscous spots in the apical cells are rather faint.

The genitalia resemble *tinealis* somewhat, but the genital styles are shorter, shorter than the pygofer, and the outer apical angles are produced into a blunt tooth. The dorsal margin is very short and the anal segment is not much produced.

Length to apex of tegmina 4.3 mm.

Holotype, male, Canal Zone, 1 Jan. 1929, C. H. C.

Allotype, female, Barro Colorado, 18 July 1924, N. B.

Paratypes, one female, Barro Colorado, 18 July 1924, N. B., one female, Barro Colorado, 15 July 1924, N. B., one female Canal Zone, 16 Jan. 1929, C. H. C., one female, Canal Zone, 21 Jan. 1929, C. H. C.

Tribe STENOPHLEPSINI

This tribe may be distinguished by the following characters: sinus of the compound eyes ventral; cheeks with a subantennal process; venation sometimes reduced. There are at least four genera in this tribe, the species range from the Oriental Region through the East Indies to New Guinea, the Solomon Islands and Australia.

Subfamily CIXIINÆ

In this subfamily the head is simple; the sinus of the compound eyes is ventral, subantennal processes are wanting; venation relatively simple; ovipositor often incomplete. About eighty genera are known from all parts of the world.

Tribe BENNINI

In this tribe the tegminae are steeply tectiform and the fourth and fifth abdominal segments are provided with processes suggestive of

those found in Achilixiidae, but the other characters are those found in the family Cixiidae. No species of this tribe have been found in Central America.

Tribe PINTALIINI

In this tribe the tegminae are usually steeply tectiform, with the body more or less compressed and the female pygofer is broadly inflated. As Muir suggests (1923f: 222) this may not be a valid character but it holds for all the genera which I have examined from various regions of the world.

Pintalia Stål

(Stål 1862e: 4)

Logotype *Pintalia lateralis* Stål, Muir 1925a: 103.

Apparently this genus has been described no less than four times. (*Cotyleceps* Uhler 1895a: 63, *Ciocixius* Metcalf 1923a: 183, *Metabrixia* Fowler 1904b: 86). The genus is composed of about 20 species which have a fairly wide range from Southeastern United States, as far north as Virginia; through Mexico, Central America and Brazil, as far south as Rio de Janeiro. The genus may be briefly characterized as follows: the vertex is separated from the frons by two slightly arcuate transverse carinae which are nearly parallel to each other and are not contiguous on the median line as in some of our common genera; mesonotum tricarinate; tegminae steeply tectiform with radius 3-branched and media 5-branched, first medial sector branched at about the same distance from apical margin as second medial sector; the pygofer of the female is fairly robust; the male pygofer is deeply incised posteriorly with a distinct median tooth at the bottom of the incision, the genital plates are broadly expanded apically with slender basal petioles.

The following purely tentative key based largely on incomplete descriptions of some of the South American forms may aid in the identification of the species concerned.

Key to the Species of the Genus Pintalia *Stål*

A. Posterior tibiæ armed with one or more conspicuous spines.
  B. Posterior tibiæ armed with a single spine only.
    C. Median frontal carina distinct, percurrent *1*
      1. Frons about half again as long as broad. Veins of tegminæ not granulate . . . . *fraterna* Stål 1862e: 4 (Brazil)
      1. Frons about one-third longer than broad. Veins of tegminæ granulate . . . . *consobrina* Stål 1862e: 5 (Brazil)

CC. Median frontal carina evanescent towards the apex........ *proxima* Stål 1862e: 5

BB. Posterior tibiæ armed with more than one spine.

C. Posterior tibiæ with five spines.......................... *aspersa* Fowler 1904b: 87 (Mexico, Costa Rica)

CC. Posterior tibiæ with three spines........................*1*

1. Lateral margins of the frons strongly elevated. General color pale testaceous......*lateralis* Stål 1862e: 4 (Brazil)

1. Lateral margins of the frons scarcely elevated. General color blackish........*fasciatipennis* Stål 1862e: 4 (Brazil)

CCC. Posterior tibiæ with two spines.........................*1*

1. A mid dorsal pale stripe extending to the apex of clavus; anal segment not elongate......*delicata* Fowler 1904b: 86 (Virginia, North and South Carolina, Florida, Mississippi, Texas, Mexico)

1. No mid dorsal pale stripe; anal segment of the male greatly elongate................*erecta* Metcalf (Panama)

AA. Posterior tibiæ unarmed, or spines inconspicuous.

B. Median carina of forehead obsolete.......................... *obscuripennis* Stål 1862e: 4 (Brazil)

BB. Median carina of forehead distinct, percurrent.

C. Veins of tegminæ finely but distinctly granulate..........*1*

1. General color pale. Male genital styles short, broadened apically...........*germana* Fowler (Mexico, Costa Rica)

1. General color fuscous. Male genital styles elongate, slender...*2*

2. Apical half of the tegminæ with three distinct fasciæ..... *tacta* Fowler (Mexico)

2. Apical half of the tegminæ not fasciate................ *fusca* Metcalf (Panama)

CC. Veins of corium not granulate..........................*1*

1. Crown not produced in front of eyes. Brazilian species...*2*

1. Crown produced in front of eyes. Central American species *maculata* Fowler (Guatemala)

2. Frons twice as long as broad.*inornata* Stål 1862e: 4 (Brazil)

2. Frons one and one-half times as long as broad.......... *ustulata* Stål 1862e: 5 (Brazil)

Pintalia germana Fowl.

Plates I, IV, XVII

Fowler 1904b: 87.

This species is to be distinguished by its pale colors. The body generally testaceous yellow, eyes dark brown and one or more fuscous spots on the side of the head above the eyes. The tegminae are milky

sub-hyaline with a testaceous yellow tinge; the stigma is fuscous with one or two fuscous spots on the costal margin anteriorly and an irregular row of rather indistinct spots across the corium and clavus. The veins of the tegminae are faintly granulate and the hind tibiae are without spines on the sides. The frons is elongate, nearly twice as long as its greatest width; the median carina is percurrent; and the lateral margins are strongly elevated. The lateral margins of the crown are not strongly elevated.

Four males, and four females from Barro Colorado, July 13, N. B.

Pintalia tacta Fowl.

Plates I, IV

Fowler 1904b: 88.

There are two females identified as this species. It is a small dark colored species, with the general color yellowish brown; the tegminae dark heavily marked with fuscous fasciae; one from the basal cell diagonally across the clavus, a second narrow broken one across the corium half way to the stigma, a broad one before and two behind the stigma. The forehead is rather broad, the median carina percurrent. Hind tibiae without spines. Veins of the tegmina granulate.

Pintalia maculata Fowl.

Fowler 1904b: 88.

This species bears a general resemblance to *tacta* Fowler but is somewhat larger and the markings on the tegminae are much more irregular. The lateral margins of the crown are more elevated. The frons is distinctly narrow between the eyes broader below and then suddenly narrowed to the clypeal margin.

Pintalia fusca spec. nov.

Plate XVII

In general structure like *germana* Fowler but male genitalia very distinct. In general color like *tacta* Fowler but the markings not distinct, but with the veins of the tegmina distinctly granulate.

Crown projecting in front of eyes; lateral margins strongly elevated; transverse carina distinct. Forehead narrow elongate, but little

widened below the antennae; median carina percurrent; lateral margins strongly elevated. Antennae short and robust. Ocelli distinct. Pronotum rather elongate for this genus. Mesonotum large; median carina indistinct. Tegminae with stigma narrow elongate; radius four-branched; media five branched.

Male genitalia: Pygofer deeply and broadly incised posteriorly; median tooth short triangular; genital styles elongate, slender, with a quadrate tooth on the median margin near the base, the apices slender terete and converging.

General color of body and tegmina yellowish fuscous with the tegmina clouded with darker fuscous along the costal margin and apical area.

Length to apex of tegminae 6.2 mm.

Holotype male, Barro Colorado, July 19, 1924, N. B.

Allotype female, Barro Colorado, July 20, 1924, N. B.

Paratypes one male and seven females, various days in July 1924, N. B.

Pintalia erecta spec. nov.

Plate XXIII

This is a uniform tawny species with the tegminae irregularly marked with fuscous. The male genitalia are distinct; the anal segment is produced ventrally into a long spatulate process.

Length to apex of tegminae 6.5 mm.

Holotype male, Barro Colorado, July 1923, R. C. Shannon. In National Museum Collection.

Tribe CIXIINI

In this tribe the body is not usually compressed; the tegminæ are not usually steeply tectiform; the ovipositor is not complete and the pygofer is broad and flat. This tribe may be readily divided into two subtribes; Cixiina with media arising from the basal cell, and Myndina with media arising from the subcostal-radial stem.

Subtribe MYNDINA

This name is proposed for that group of genera including *Oecleus* Stål, *Myndus* Stål and many others in which subcosta, radius, and media form a common stalk from the basal cell.

Oecleus Stål

(Stål 1862a: 306)

Logotype *Oecleus seminiger* Stål, Oshanin 1912a: 117.

This genus may be recognized by its narrow trough-like vertex, quinque-carinate mesonotum and transparent wings with characteristic venation; radius short, branches of media short making elongate basal cells, short and fairly broad subapical and small apical cells.

Oecleus concinnus Fowl.

Plate IV

Fowler 1904b: 91.

There is a single female specimen from Las Sanas, Panama, July 7, 1924, N. B., in this collection which we place in this species with some hesitation. It has the general coloration of *O. addendus* Fowler but the crown projects distinctly in front of eyes and is not so narrow as in *addendus*. It may be placed here until males can be examined to determine its true location.

Subtribe CIXIINA

This subtribe is proposed for that group of genera including *Cixius* Latreille, *Mnemosyne* Stål, *Oliarus* Stål, and others which have media arising from the basal cell.

Muirolonia nom. nov.

For *Olonia* Muir 1925 (Cixiidæ) [nec *Olonia* Stål 1862 (Eurybrachydidæ)]. Orthotype *Bothriocerodes metallicus* Fowler.

This is a very distinct genus with only a single species. It gives me great pleasure to dedicate it to the late Fredrick Muir who has done so much to advance the study of the Fulgorina of the world.

Muirolonia metallicus Fowl.

Plates I, IV, XVII

Fowler 1904b: 85.

This interesting species was described by Fowler from Panama. We have a series of four females, Barro Colorado, July 20, 1924, N. B. The general color is metallic bluish black with the lateral margins of

the frons below, and the legs testaceous yellow, the abdominal segments are margined with red or yellow. Fowler says that this species differs from the other species but does not specify what the differences are. In the specimens before me the forehead is not as elongate as in *Bothriocerodes castaneus*, the clypeus more elongate, the median carina well elevated on forehead and crown branching near base, the forks of the carina combined on the lateral margins of the crown which is more elevated than Fowler shows in his figure. One of the specimens has the tegmina densely clothed with pale golden hairs. The ovipositors are extremely long, as long as or longer than the basal segments of the abdomen with the sheaths about twice as long as pygofers. The other characters may be observed in the illustrations.

Mnemosyne Stål

(Stål 1866c: 391)

Haplotype *Mnemosyne cubana* Stål.

This genus includes some eleven species at the present time, one from Cuba, one from Central and South America, three from Africa and six from India and the East Indies, athough the location of the African and Oriental species in this genus is doubtful.

The species of this genus resemble in general appearances a large *Oliarus*. They may be recognized readily by the tricarinate mesonotum, typical venation, and the series of fuscous granules in longitudinal rows on the apical and subapical cells.

Mnemosyne planiceps Fabr.

Plates XV, XVII

Fabricius 1803a: 48, Stål 1869a: 91.

Fowler makes *M. cubana* Stål (from Cuba) synonymous with this species but this is certainly incorrect. Typical specimens from Cuba are distinct in general structure, male genitalia, and color.

There is quite a series from Barro Colorado which agrees in general with Stål's description from the type. This species would seem to have a fairly wide range from Panama and British Guiana into South America.

Although the color is very variable, the male genitalia are quite distinctive.

Oliarus Stål

(Stål 1862a: 306)

Logotype *Oliarus walkeri* Stål, Distant 1906i: 256.

This is a world wide complex of nearly 300 species. Ball has recently revised the species from North America. His key to species is based largely on female color characters. In the species known to us this character is not reliable.

Male genitalia are reliable criteria but unfortunately real correlation of the sexes is not always possible. Until this is more carefully done we shall not accept the synonyms recently proposed.

Oliarus excelsus Fowl.

Plate IV

Fowler 1904b: 92.

We have a single female, Barro Colorado, June 23, N. B. which we place here with some hesitation. It has a single interrupted band before the middle of corium and some scattered fuscous markings on apex of tegminae, thus agreeing very well with Fowler's figure but the general color is paler and the face is entirely testaceous. Otherwise especially in the narrow vertex, the specimen agrees very well.

Oliarus omani spec. nov.

Plates IV, XVII

This is a very large species with a very narrow crown, with the forehead much narrowed between the eyes, the tegminae impunctate and distinctive genitalia.

Crown narrow, deeply impressed, its length three times its basal width; apical fovea deep, about twice as long as wide; face diamond shaped, more than twice as long as wide, the lateral margins strongly reflexed, median carina percurrent, distinct; clypeal suture indistinct; median ocellus evident. Antennae very short. Pronotum short, flaring, posterior margin deeply incised, the lateral carinae bordering the eyes. Mesonotum broad; the intermediate carinae complete. Tegminæ narrow; stem of subcosta and radius long; stigma large; media three plus four about five times as long as media one plus two. Hind tibiæ with two stout spines on the middle third. Male genitalia distinctive;

median tooth of pygofer simple, triangular, short about as long as its basal width.

General body color ochraceous tawny, ochraceous buff on the pronotum and the face, with blackish fuscous markings as follows: A median stripe on the crown; an irregular spot either side of the median carina of the face, at the level of the median ocellus; the sides of the labrum; the median area of the mesonotum between the intermediate carinæ; a longitudinal stripe laterad of the lateral carinæ; and the lateral areas of the abdominal segments ventrally. The legs are ochraceous tawny with the femora and tibiæ mostly fuscous. The tegminæ are transparent, shiny, without markings save the blackish stigma which is broadly ochraceous anteriorly, the three cross veins in the median area before the apex and the apical margin which is broadly clouded with fuscous.

Length to apex of tegmina, male, 11.5 mm.; female, 12.5 mm.

Holotype, male, Panama, May 2, 1911, August Busck.

Allotype, female, Panama, May 2, 1911, August Busck.

Paratypes, four males and four females, same locality.

This is the largest American *Oliarus* known to me, suggesting *Mnemosyne* Stål. I take pleasure in naming it for Mr. Paul Oman, curator of Homoptera in the United States National Museum, who has sent me many interesting Fulgoridæ from the National Museum collections.

Oliarus concinnulus Fowl.

Plate IV

Fowler 1904b: 92.

There is a single small female in the present collection, Barro Colorado, June 23, 1924, N. B., that we place here. It has milky hyaline tegminæ with black veins, and a somewhat narrower crown than Fowler shows in his illustration, but without a male I cannot place it more exactly.

Family ARAEOPIDÆ

(Family *Delphacidæ*)

The generic name *Delphax* Fabricius 1798a: 511 is preoccupied by *Delphax* Walbaum 1792 (Mammalia). The next available name is *Araeopus* Spinola 1839, which will replace *Delphax* Fabricius and the family name will be ARAEOPIDÆ.

The members of this family are all small or minute insects. They are represented in the present collections by a very few specimens, most of which are exceedingly interesting, indicating that much more extended collections should be made especially in tropical America. This family may be recognized by the presence of a peculiar spine or calcar between the basitarsi and tibiæ of the hind legs. This was originally shaped like a typical spine no doubt, but has been variously modified in the different genera. The function of the calcar is not known. Most of the specimens in the present collections are females and specific determinations can be made only by the examination of the male genitalia. Nevertheless I have attempted, with the aid of the figures in the Biologia, to place these females and given such notes as seem to me pertinent in each case.

Subfamily ASIRACINÆ

In this subfamily the calcar is subulate, awl-like or spinous either circular in outline or not.

Eucanyra Crawf.

(Crawford 1914a: 568)

Orthotype *Eucanyra stigmata* Crawford.

This genus belongs to that group of genera of the subfamily ASIRACINÆ which have a quinquecarinate mesonotum; elongate antennæ, with the first and second segments subequal; and a single median facial carina. This group includes the genera *Canyra* Stål 1862e: 7, *Eucanyra* Crawford 1914a: 568, *Epibidis* Fowler 1905a: 131, and possibly *Ugyops* Guerin-Meneville 1834a: 477. Although no one has made a thorough study of the genus *Ugyops* in modern times an examination of the genitalia and other morphological characters and geographic distribution would seem to indicate that the genus is a composite of several divergent elements. Apparently every species with elongate antennæ and subulate calcar has been included in the genus *Ugyops*. Some of these forms have a single median facial carina either forked or not, while others have two carinæ on the face. Some species have the first segment of the antennæ as long as the second while others have it about half as long. Some species have granulations on the veins of the tegminæ bearing setæ while others lack this character. Some species have complicated genitalia whereas other species have very

simple genitalia. Species have been described from Japan, Cochin-China and the Malay Peninsula throughout the East Indies to New Guinea, Queensland, New Hebrides and Samoa; also from Porto Rico and the Seychelles Islands.

The outstanding characters which will be useful in separating the other three genera may be summarized as follows: *Canyra*, first segment of antennæ sulcate above, veins of tegmina not granulate; Sc—R forked basad of cubitus. *Epibidis*, first segment of antennæ prismatic, veins of the tegmina granulate, setigerous, stigma indistinct, pygofer short robust; genital styles nearly as long as pygofer. *Eucanyra*, first segment of antennæ terete, stigma distinct with a distinct transverse vein from stigma to apex of clavus, pygofer elongate, genital styles short, anal segment asymmetrical.

Eucanyra stigmata Crawf.

Plates I, IV, XVII

Crawford 1914a: 569.

We have a series of one male and three females from Barro Colorado collected by H. F. Schwarz, and another series of one male and six females collected by N. Banks. This species is apparently very variable in color, some specimens having the tegmina sparsely maculate with small fuscous spots, in others the fuscous maculations coalesce so that they cover most of the area of the tegmina, while in others the fuscous markings form a distinct vitta from the base to the apex of the tegmina. So far as I am aware this is the only genus of Araeopids with asymmetrical male genitalia.

Subfamily ARÆOPINÆ

In this subfamily the calcar is flattened, sometimes very greatly flattened and leaf like with or without teeth on the posterior margin.

Tribe ARÆOPINI

In this tribe the calcar is thin often foliaceous or tectiform and with teeth, sometimes very minute, always present on the hind margin. This tribe includes the majority of our commoner genera.

Liburnia Stål

(Stål 1866a: 179)

Logotype *Liburnia vittacollis* Muir and Giffard 1924a: 12.

Liburnia was formerly used for species now assigned to *Delphacodes* Fieber. Muir and Giffard have recently restricted this genus and given *vittacollis* as the type. This appears to make it include *Sogata* Distant. As thus defined it has nearly a world wide distribution and 51 species. The members of this genus are slender elongate forms with a narrow crown which is not greatly produced in front of the eyes; forehead narrow elongate, lateral margins nearly straight, not distinctly narrowed between the eyes. In the species known to me the genital styles are flat with the inner and outer apical angles strongly produced and the anal spines are strongly produced.

Liburnia furcifera Horv.

Horvath 1899a: 372. Equals *Liburnia albolineosa* Fowler 1905a: 135.

A single teneral female from Barro Colorado seems to belong to this widely distributed species.

Furcifera seems to have the widest distribution of the species of *Liburnia* being known from Japan, Formosa, China, Indo-China, India, Ceylon, Sumatra, Philippines, Sebesi, Amboina, Ceram, Queensland, Fiji, Ecuador, Brazil, British Guiana, Central America, Mexico, Southern United States, Cuba and the West Indies, Bermudas, Nigeria, South Africa, East Africa, Seychelles Islands, Egypt, Sicily, South Europe, Manchuria, Siberia.

Pissonotus Van Duzee

(Van Duzee 1897a: 236)

Orthotype *Pissonotus marginatus* Van Duzee.

As now constituted this genus contains 19 species from North America, 3 from the West Indies and 6 from South America ranging as far south as Brazil. Many of the species are known only from brachypterous specimens, a few from macropterous specimens and in only a few cases have both types of individuals been collected. As these two types of individuals differ in most characters save the phallic

characters it is unwise to describe new species without males. There are in our collections two macropterous females from Barro Colorado which I cannot correlate with any species from North or South America or any species illustrated in the Biologia. But until males are in hand I hesitate to describe them as new.

Both specimens are black with pale legs; in one specimen, the eyes are black and the tegminæ strongly infuscated, in the other the eyes are pale and the tegminæ are milky subhyaline.

Delphacodes Fieb.

(Fieber 1866b: 524)

Logotype *Delphacodes mulsanti* Fieber.

As now constituted this is a complex of 172 species with species known from every region of the world. Most of the North American species formerly placed in the genus *Liburnia* Stål are now placed in this genus.

As constituted at present this genus may be characterized as follows: head nearly as broad as pronotum; vertex short, but little, if any longer, than broad; frons narrow elongate, lateral and median carinæ distinct, the later forked near apex of head; antennæ terete; tegminæ brachypterous, koelopterous or macropterous; calcar cultrate, concave, teeth on hind margin usually very minute.

In the Barro Colorado material there are four females representing two species. While it is impossible to determine females in this genus with absolute accuracy, I have placed them as follows.

Delphacodes sagata Fowl.

Fowler 1905a: 136; pl. 13, figs. 17, 17a–b.

This species was described from brachypterous males.

There are three specimens with macropterous wings which I believe represent this species. The vertex, pronotum and mesonotum are chiefly dirty white with the intercarinal areas clouded with fuscous; the face is black with the carinæ conspicuously white; the tegminæ are transparent with the veins distinctly punctate.

Delphacodes sp.

There is also a single koelopterous female in the Barro Colorado material which I cannot place from the material in the Biologia. It is pale ochraceous with the frontal carinæ edged with darker. In these respects it resembles a pale *Delphacodes detecta* Van Duzee, and since *detecta* has such a wide range in North America the present form may prove to be that species. However, there are a number of characters which do not agree well enough to place it in *detecta* without males for comparison. The head is shorter and broader, the crown is broader than long instead of the reverse; the pronotum is short, about one fourth as long as mesonotum, not about half as long as it is in *detecta*. However until more material is available it would be unwise to give a specific determination.

Kelisia Fieb.

(Fieber 1866b: 519)

Haplotype *Delphax guttula* Germar.

This is another complex of about 35 known species from various parts of the world, chiefly Europe and North America. Muir has recently described 9 species from South America which he says are not typical. These nine species seem to represent five distinct groups. There is a single female specimen in the Barro Colorado material that has the typical chrotic characters usually given for this genus but since there are no males it would be impossible to place it specifically. Its general color is ochraceous yellow, the tegminæ tinged with the same color and the veins have a single black dot on the apical margin. There is a pair of orange vittæ from the apex of the head to the apex of the mesonotum.

Tribe ALOHINI

This tribe includes a few genera which have a cultrate calcar, that is with the calcar thick on the anterior margin with both surfaces convex and with distinct teeth on the posterior margin.

The center for this tribe seems to be in the Pacific Islands, but the common European genus *Stiroma* Fieber and the common American genus *Stobaera* Stål belong to this tribe, and the recently described genus *Burnilia* Muir and Giffard which includes *Delphax pictifrons* (Stål 1864a: 50) from the Central American region is also included but I have not seen it.

Stobaera Stål

(Stål 1859a: 327)

Haplotype *Delphax concinna* Stål.

This strictly North American genus contains a dozen species, seven from North of Mexico.

It may be briefly characterized as follows: head rather broad, but narrower than pronotum; vertex nearly quadrangular; frons elongate nearly parallel-sided, with a distinct median carina; cheeks broad; eyes deeply emarginate; antennæ elongate, flattened, first segment broadly triangular; second segment elongate, parallel-sided. Pronotum elongate the lateral carinæ divergingly curved then suddenly bent reaching posterior margin. Veins punctate, setigerous. Calcar cultrate with distinct teeth on posterior margin.

Stobaera testaceum Fowl.

Fowler 1905a: 133.

There is a single female specimen which agrees with the description and illustration given by Fowler. If this is correct, however, the species *testaceum* does not belong to *Stobaera* Stål. The antennæ are not flattened but the first segment is elongate terete; the frons is elongate narrow and parallel-sided, the vertex is broad, the pronotum is nearly parallel-margined and the intermediate carinæ are nearly straight but diverging. The calcar is thin concave with distinct teeth on the posterior margin. But since it would require examination of male specimens to determine this point definitely I prefer to leave it as assigned at present.

Tribe TROPIDOCEPHALINI

This tribe includes those genera with the calcar generally rather thick but concave on one surface and without teeth on the hind margin. The common American genus *Liburniella* Crawford belongs here and several genera and species from the Neotropical region have been described but none are included in the present collection.

Family DERBIDÆ

This is a family of fulgorids with small bodies and usually elongate fragile tegminæ; the antennæ are variously modified; the head is frequently compressed with the forehead and crown very narrow; the beak

is usually short with the terminal segment short or minute; the tegminæ are usually much elongate and the venation is frequently much modified, in many genera stridulating organs are present on the basal portion of the costal or subcostal veins, and some of the larger species are said to produce sounds audible to the human ear. The wings are small, sometimes minute. The legs are slender. The male genitalia have the genital styles horizontal laminate and variously modified.

Key to the Subfamilies and Tribes of the DERBIDAE

A. Tegminæ long and narrow. Wings very small, not more than half as long as tegminæ; venation of wings greatly reduced. Subfamily ZORAIDINÆ

B. Base of clypeus reaching to the level of the lower margin of the eyes. Subcostal cell short, or absent . . . Tribe SIKAIANINI (One genus in North America. *Euklastus* Metcalf)

BB. Base of clypeus not reaching to the level of the lower margin of the eyes. Subcostal cell long . . . . Tribe ZORAIDINI (Not represented in the Americas)

AA. Wings more than half as long as the tegminæ, if the wings are small venation not greatly reduced. . . . . Subfamily DERBINAE

B. Clavus closed; or if narrowly opened, the claval stem not extending beyond the claval suture.

C. First cubital sector with three or more branches . . . . Tribe DERBINI

CC. First cubital sector with less than three branches *1*

1. Tegmina broad; first cubital sector merging with media . . Tribe RHOTANINI (No American genera)

1. First cubital sector not merging with media, simple or bifurcate . . . . Tribe CENCHREINI

BB. Clavus open, the claval stem extending as a submarginal vein around the apex of the tegminæ . . . . Tribe OTIOCERINI

Subfamily ZORAIDINÆ

In this subfamily the tegminæ are relatively long or very long, the wings are small or very small with reduced venation. There are numerous genera and species in the Ethiopian, Oriental, Malayan, Papuan and Australian Regions. Only one species is known from the Polynesian Region and one from the Nearctic Region, others perhaps await discovery in the Nearctic Region.

Tribe ZORAIDINI

This is the larger of the two tribes of the subfamily ZORAIDINÆ. The eyes and clypeus are relatively small so that the ventral

margin of the eyes is distinctly above the dorsal margin of the clypeus; the subcostal cell is elongate and narrow. No American genera are known for this tribe.

Tribe SIKAIANINI

This is a small tribe of six known genera all with a small number of species which are widely distributed in the southern half of the eastern hemisphere. Only one species is known from North America.

In this tribe the eyes are extended ventrad until they almost reach the dorsal margin of the clypeus; the subcostal cell is absent or very small.

Euklastus Metc.

(Metcalf 1923a: 194)

Orthotype *Euklastus harti* Metcalf.

Muir (1926f: 240) suggests that this may be the same as *Sikaiana* Distant. I cannot concur in this. The shapes of the foreheads are entirely different. The antennæ in *Euklastus* are more elongate, the second joint is not robust and constricted on the apical third but is broad and flattened, the flagellum is subterminal, not terminal; the frons is linear throughout, not widened apically as in *Sikaiana;* the clypeus represents hardly a third of the total length of the face; the vertex and pronotum are deeply excavated posteriorly and the mesonotum is ecarinate, not tricarinate as in *Sikaiana.* The venation is quite similar. Ball (1928b) states that, "The two illustrations of the venation in Metcalf's original drawings are quite different." The two illustrations are from different wings and the only difference is the point of origin of media two. Since there is frequently more variation in wing venation than this in this group and since the specimen has long since passed from our hands we cannot verify the matter and will consider this of minor importance only.

Subfamily DERBINÆ

In this subfamily the tegminæ are large and the wings are rather large with the venation not greatly reduced; the antennæ are frequently greatly modified.

Numerous genera and species are known from practically all regions of the world.

Key to the Genera of the Tribe DERBINI

A. Shoulder keels on pronotum large.................*Zeugma* Westwood
(No American species in this genus)

AA. Shoulder keels on pronotum absent or small.

B. Media with two sectors, the first dichotomously five-branched, the second pectinately 7–8 branched. Stridulating organs on the stems of both subcosta plus radius and media.........*Derbe* Westwood

BB. Media with three or four sectors, branches not pectinately arranged.

C. Cubitus one with three sectors the second branched. Media with seven apical branches..............*Mysidia* Westwood

CC. Cubitus one with three sectors all unbranched. Media with eleven apical branches..............*Pseudomysidia* Metcalf

Derbe Fabr.

(Westwood 1840d: 83)

Logotype *Derbe hæmorrhoidalis* Fabr.

This is a genus of relatively large species of Derbids with large tegminæ with media with two sectors, the second pectinately branched. The true species of *Derbe* range from Central America to Brazil.

Key to the Central American Species of DERBE

A. Color of fore and hind wings dark fuscous; venation almost concolorous, distinctly bordered by paler..........................*muiri* Metcalf

AA. Color of fore and hind wings yellowish hyaline the cells more or less clouded with fuscous; the veins dark brownish fuscous, distinct.

B. Anal segment of female small, sunk into the pregenital tergite....
championi Muir 1918c: 230 (Panama)

BB. Anal segment of female large, almost as long as genital styles.

C. Anal segment of female with long processes..............*1*

1. Genital styles of female spinous at apex, the spines turned mesad.................*bergrothi* Muir 1923h: 67 (Brazil)

1. Genital styles of female not spinous at apex...........*2*

2. Subgenital plate truncate apically; tegminæ yellowish with a few fuscous clouds *fowleri* Muir 1918c: 230 (Guatemala)

2. Subgenital plate angulate apically; tegminæ yellowish, heavily clouded with fuscous.............*buscki* Metcalf

2. Subgenital plate produced into an elongate slender acute tooth..................................*currani* Metcalf

CC. Anal segment with a shallow v-shaped notch posteriorly. Pregenital plate small, acute at apex......*westwoodi* Fowler

DERBE WESTWOODI Fowl.

Plate XVIII

Fowler 1900g: 71

A single male from Barro Colorado, July 15, 1924, N. B., agrees in general with Fowler's description and differs from *D. championi* Muir in having less fuscous clouding in the cells and in having larger genital styles. It agrees with *D. fowleri* Muir in general coloring but the genitalia are decidedly different. The anal segment is notched at the apex with the processes short. The genital plate is short triangular with the apex acute.

When viewed dorsally the anal segment is broad about two and one half times as long as wide, nearly parallel sided for about two-thirds its length then uniformly narrowed to the blunt apex which is a deep notch; the base is narrow suddenly and almost rectangularly widened; the dorsal crest is not conspicuous; the dorsal notch is deep basally and shallow posteriorly. The anal segment is short and blunt. When viewed laterally the anal segment is broad and flat and ends in a broad triangular tooth. The genital styles are slender with a definite ridge from base to apex; the apex is recurved and ends in a slender recurved tooth. The ultimate ventral segment is about twice as long as broad bluntly triangular apically.

DERBE MUIRI spec. nov.

Plates I, XVIII, XIX

Distinguished at once from the other species of Central American *Derbe* by its dark fuscous color. Apparently closest to *D. punctum* Fabr. from South America.

Crown distinctly impressed; forehead elongate nearly parallel margined. Antennæ with second joint terete, twice as long as the long diameter of the eye. Pronotum collar-like broadly flaring. Mesonotum broad, strongly arched, with two conspicuous callosities on the posterior margin, with three distinct carinæ. Venation typical, radius 2-branched, media 12-branched, cubitus 5-branched.

When viewed dorsally the anal segment is long and narrow nearly three and one half times as long as its greatest width; the base is narrow, gradually widened to about one fourth from base and then ovally narrowed to the blunt apex which has a broad triangular notch; the dorsal crest is conspicuous and the dorsal notch broad of nearly

uniform depth to the apex of the segment and bordered by distinct carinæ on each side.

When viewed laterally the anal segment of the male is slender with the apex bent at right angles and ending in a slender acute tooth. The genital styles are broad nearly rectangular in outline with the apex obtuse with a conspicuous tooth directed toward the median line. There is a very conspicuous somewhat sinuate ridge from base to apex. The dorsal margin has a broad scroll-shaped tooth. The ultimate ventral segment is about three times as broad as long with the posterior margin broadly concave.

The female subgenital plate is large, the posterior margin is triangularly notched on either side and produced into a median triangular tooth. The genital styles are broad, short, about as long as the ovipositors and blunt apically. The anal segment is not long but is produced as slender processes which are about as long as the short ovipositors.

Length to apex of abdomen 7.5 mm.; wing expanse 30 mm.

Holotype, male, Barro Colorado, 15 July 1924, N. B.

Allotype, female, Barro Colorado, 15 July 1924, N. B.

Paratype, male, Barro Colorado, 15 July 1924, N. B.

Derbe buscki spec. nov.

Plate XIX

This species resembles *Derbe fowleri* Muir in structural characters but differs decidedly in color and in details of structure.

General color of the body blackish and yellowish fuscous. Crown and pronotum blackish; mesonotum and metanotum brownish; abdomen bright yellow with the margins and a mid-dorsal stripe black. Tegminæ and wings transparent, faintly tinged with yellow, and heavily marked with fuscous. Typically there is a large fuscous cloud on the corium at the apex of the clavus, another extending from the apical margin to the radius, this is separated by a narrow transparent area from a third which extends from the apex of the costal margin to the apical margin enclosing a transparent nearly circular area, at the extreme apex of the tegminæ many of the cells and cross veins are clouded with fuscous. The legs and ventral parts of the body are generally yellowish fuscous shading to blackish fuscous on the carinæ, apex of the clypeus and genitalia.

Forehead and clypeus narrow, nearly parallel-sided throughout. Antennæ short, slender; the second segment as long as the great diame-

ter of the eye. Female subgenital plate about as long as broad, angulate apically; genital styles elongate narrow acute at the apex not as long as ovipositors which have a crown of three or four teeth apically. Anal segment with a ventral plate which extends in a pair of elongate flagellate processes as long as the ovipositors.

Length to apex of abdomen 7.8 mm.; wing expanse 28.2 mm.

Holotype, female, Porto Bello, Panama, 15 Feb. 1911, A. Busck, United States National Museum.

Paratypes, four males, Porto Bello, Panama, 15 Feb. 1911, A. Busck, United States National Museum.

Derbe curran i spec. nov.

Plate XIX

This species resembles *Derbe westwoodi* Fowler in general appearances but the genitalia are similar to *D. fowleri* Muir.

General color dark fuscous. Head fuscous with the eyes, most of cheeks and the sides of the clypeus pale greenish yellow. Pronotum chiefly greenish yellow with an irregular fuscous cloud behind the eyes. Mesonotum chiefly blackish fuscous with the posterior margin pale greenish yellow and a conspicuous black shining callosity at the middle of either side. Tegulæ greenish yellow with the posterior border brownish fuscous. Tegminæ more brownish than in *westwoodi* with the basal cells clouded with fuscous, a fuscous cloud on the costal margin near apex and another on the anal margin beyond the apex of clavus much as in *westwoodi*. Metanotum fuscous. Hind wings brownish the veins brown and the basal cells and apical angle clouded with fuscous. Abdomen above fuscous, the posterior margins narrowly greenish yellow. Under parts and legs drab gray; genital plate blackish fuscous.

Forehead narrow, parallel-sided, deeply impressed. Cheeks broad. Antennæ elongate, slender; second segment longer than the diameter of the eye. Pronotum long, anterior margin carinate and a distinct callosity behind each eye. Mesonotum rather distinctly tricarinate. Tegulæ large. Subgenital plate large, the posterior margins converging, then produced into a small quadrate plate which is prolonged caudad in an elongate, slender, acute tooth. Genital styles slender, elongate, acute. Anal segment with terminal flagella which are longer than the ovipositors.

Length to apex of abdomen 8.4 mm.; wing expanse 36 mm.

Holotype, female, Barro Colorado, 23 Nov. 1930.

Named for Dr. C. H. Curran of the American Museum of Natural

History who has sent me many interesting fulgorids from Barro Colorado.

Mysidia Westw.

(Westwood 1840d: 83)

Logotype *Derbe pallida* Fabr., Kirkaldy 1903c: 216.

This is a genus of median or medium small species, of various colors but quite frequently pale or whitish in color. About 27 species are known ranging from the Southern United States to Brazil. The species are all frail and the genitalia are quite distinct.

Key to the Species of Mysidia *Westwood*

A. Color of tegminæ and wings pale bluish . . . .
glauca Distant 1907e: 397 (Brazil)

AA. Color of tegminæ and wings whitish or yellowish.

B. Crown usually longer than pronotum; crown, between the frontal carinæ, produced in front of eyes.

C. Tegminæ milky subhyaline often densely covered with white wax, not marked with fuscous except on some of the veins and cross veins and along the costa . . . .
costata Fabricius (Stål 1869a: 97) (Guatemala, Panama)

CC. Tegminæ marked with fuscous *1*

1. Size small. Wing expanse about 11 mm. *2*
1. Size large, wing expanse 15 mm. or more *3*
2. Body scarlet, tegminæ hyaline . . . .
rubidella Ball 1928b: 199 (Mexico)
2. Body testaceous, tegminæ heavily marked with fuscous. Some of the median and cubital sectors with distinct black points. . . . . *nigropunctata* Metcalf (Canal Zone)
3. Color of body bright red. Tegminæ brownish, veins black . *caliginosa* Walker 1858b: 98 (Brazil)
3. Color pale, tegminæ more or less marked with milky subhyaline *4*
4. Longitudinal veins dotted with fuscous on apical margin . .
maculicosta Fowler 1900g: 73 (Guatemala, Costa Rica)
4. Longitudinal veins not dotted with fuscous on apical margin 5
5. Clypeus tricarinate, that is with a distinct median and lateral carinæ *6*
5. Clypeus not tricarinate *12*
6. Prothoracic shield with a large round black spot; tegulæ black . . . . *squamigera* Fabricius (Stål 1869a: 97) (Brazil)

6. Prothoracic shield without spots, tegulæ concolorous. . . . *7*
7. Tegminæ whitish hyaline with fuscous markings; with a distinct black puncture at the forking of media one. *8*
7. Tegminæ chiefly pale fuscous marked with narrow transverse milky fascia; without a black puncture at forking of media one. *9*
8. Second antennal segment about three times as long as basal width. . . . .
   punctum Fabricius (Stål 1869a: 98) (Brazil, Venezuela)
8. Second antennal segment about five times as long as basal width. . . . . *punctifera* Metcalf
9. Size large, wing expanse about 30 mm. . . . *obscura* Metcalf
9. Size smaller, wing expanse less than 20 mm. *10*
10. Crown narrow elongate, nearly parallel sided *11*
10. Crown short broad, triangular in outline . . . .
    subfusca Metcalf (Canal Zone)
11. Female subgenital plate about twice as broad as long, roundly produced caudad . *pallescens* Metcalf (Canal Zone)
11. Female subgenital plate nearly quadrate, broadly notched caudad. . . . . *fasciata* Metcalf (Canal Zone)
12. Clypeus with a distinct median carina *13*
12. Clypeus not carinate or very obscurely carinate *14*
13. Second antennal segment more than twice as long as broad.
    mississippiensis Dozier 1922a: 82
13. Second antennal segment not more than half as long as width at apex. *pallida* Fabricius (Stål 1869a: 99) (Brazil)
14. General color of body pale stramineous. Tegminæ with a short transverse fuscous fascia on basal third. . . . .
    steinbachi Distant 1907e: 396 (Bolivia)
14. General color of body testaceous. Tegminæ with apical and commissural margins marked with fuscous. . . . .
    testacea Fabricus (Stål 1869a: 98) (South America)

BB. Crown usually shorter than pronotum; crown between frontal carinæ not produced in front of eyes.

C. Tegminæ with transverse fuscous fascia or spots *1*

1. Wings with transverse fascia *2*
1. Wings with spots, no transverse fascia. . . . .
   albicans Stål 1855b: 191 (Brazil)
2. Some of the apical cells of tegminæ with marginal black dots *3*
2. Without black dots in the apical cells. *5*
3. Genital styles broadest at apex . . . .
   neonebulosa Muir 1918a: 424 (British Guiana)
3. Genital styles narrowed apically *4*

4. Internal tooth on genital style basal . . . .
pseudonebulosa Muir 1918a: 423 (British Guiana)
4. Internal tooth on genital style beyond middle . . . .
nebulosa Muir 1918a: 423 (Fowler 1905a: Pl. 13) (Brazil, Guatemala, Panama)
5. Apical veins with black dots before apex . . . .
subfasciata Westwood 1840d: 83 (Brazil)
5. Apical veins without black dots . . . .
quadrifascia Walker 1858b: 97 (Brazil)

CC. Tegminæ without transverse fuscous markings save on the veins *1*

1. Fore or hind wings with distinct dots in the marginal cells . *2*
1. No black dots in the marginal cells *3*
2. Fore and hind wings with distinct dots in the marginal cells . . . . *acidalioides* Fowler 1900g: 72; Pl. 8 (Panama)
2. Hind wings only with distinct dots in the marginal cells . .
parviceps Fowler 1900g: 73; Pl. 8 (Guatemala)
2. Tegmina only with two black dots in the marginal cells . . .
jamaicensis Distant 1907e: 396 (Jamaica)
3. Clavus with distinct round black dots *4*
3. Clavus without distinct round black dots *6*
4. Clavus with two black dots . . . .
albipennis Westwood 1840d: 83 (Mexico, Honduras)
4. Clavus with a single black dot *5*
5. Costal margin with three black dots towards the base . . . .
lactiflora Westwood 1840d: 83 (Brazil)
5. Costal margin without black dots 6
6. Costal and claval margins of the tegminæ brownish, cross veins unmarked . . . . *citrina* Walker 1858b: 98 (Brazil)
6. Margins of the tegminæ not brownish, cross veins blackish a single black spot in the costal cell before the apex . . . . . .
stigma Germar 1830a: 56 (Uruguay)

Mysidia costata Fabr.

Plates I, IV, XVII, XVIII

Stål 1869a: 97.

This species is represented by a single male and two female specimens from Barro Colorado, July 17, 1924, N. B., and two females, Barro Colorado, 11 Nov. 1923, and 7 Jan. 1929, C. H. C.

The body is bright tawny with the eyes and antennæ darker and a dark fuscous spot on the tegulæ. The tegminæ are milky subhyaline with the costal margin and most of the cross veins fuscous. The costal

area is broad with eleven transverse veinlets. There are eleven stridulating pustules on Sc + R. The total length of the body is 4.5 mm., of the fore wings 11.0 mm. The head is strongly projected in front of the eyes. The second segment of the antennæ is robust about twice as long as the great diameter of the eyes.

Mysidia punctifera spec. nov.

Plates XV, XVII

This species resembles *mississippiensis* Dozier in a general way. The color markings however are darker and the second segments of the antennæ are much longer and thickly studded with sensory pits. The genitalia are entirely different in the two species: in *mississippiensis* the subgenital plate of the female is elongate, produced apically with a deep triangular notch; in *punctifera* the subgenital plate is very small not produced and slightly sinuate apically.

General color of body including legs and antennæ testaceous yellow. Eyes black. Tegminæ and wings milky translucent heavily marked with fuscous, especially on the basal third of the tegminæ; there is a conspicuous spot of the same color near the apex of the tegminæ on media one; and beyond the apex of the clavus; the series of subapical transverse veins in the medio-cubital area are also heavily but narrowly marked with blackish fuscous. The wings are marked with fuscous in the apical cells and on the transverse veins.

The head is narrow and the compound eyes are large. The crown is about twice as long as basal width, strongly projecting; the forehead is narrow, gradually widening to the clypeus; the lateral carinæ are strongly elevated. The clypeus is elongated, longer than forehead, robust, with a definite median carina. The antennæ are elongate, robust, more than twice as long as the great diameter of the eye; the second segment is thickly studded with sensory pits and is deeply notched on the dorsal side at the apex. The pronotum is relatively large deeply notched posteriorly. The mesonotum is large; tegulæ large nearly circular in outline. Tegminæ broad, venation typical. Legs elongate, slender. Abdomen robust about as long as head and thorax combined; dorsal carina evident. Subgenital plate small.

Length of body 4.7 mm.; wing expanse 20.4 mm.

Holotype, female, Barro Colorado, 15 July 1924, N. B.

Mysidia punctum Fabr.

Plate XVIII

Stål 1869a: 98.

This species belongs in the same general group as *squamiger* Fabr. The following characters are distinctive. The forehead is narrow parallel-sided to below base of antennæ where it is suddenly widened to base of clypeus. Clypeus elongate, longer than forehead. Tegminæ milky subhyaline with a distinct black dot at the apex of the first median sector.

This species was described from Brazil and has been listed from Venezuela. We have a single male specimen from Barro Colorado, 13 July 1924, N. B., which seems to be this species.

Mysidia fasciata spec. nov.

Plate XVIII

This species may be distinguished from other species by its structural characters and the evident fascia across the basal third of both fore and hind wings; the crown is long; and the clypeus tricarinate.

General color of body bright yellow, irregularly marked with bright red; eyes brown. Tegminæ and wings transparent heavily marked with pale fuscous; there is a regular fascia at the apex of the basal third of the tegminæ which is continued across the hind wings; the apical two-thirds of the tegminæ are largely fuscous with irregular transparent areas. The apical border of the wings is banded with fuscous.

Crown narrow, elongate, nearly two times as long as basal width; nearly parallel-sided; projecting. Forehead narrow, the lateral carinæ nearly parallel to lower margin of eyes then gradually widening to clypeus. Clypeus tricarinate; about as long as forehead. Antennæ short, robust about as long as the great diameter of the eye. Pronotum short; the lateral flaps strongly developed. Mesonotum large, inflated; median carina fairly evident. Tegulæ small. Abdomen short, robust, shorter than head and thorax combined, dorsal crest evident. Subgenital plate large, quadrangular, apical angles rounded, the apica margin excavated.

Length of body 2.9 mm.; wing expanse 19.7 mm.

Holotype, female, Barro Colorado, 9 Jan. 1929, C. H. C.

Allotype, male, Barro Colorado, 21 June 1924, N. B.

Mysidia pallescens spec. nov.

Plate XVIII

This species may be distinguished from *squamigera* Fabricius, *punctum* Fabricius and related species by its pale fuscous fore wings marked with milky subhyaline; narrow crown which is parallel-sided and by the large subgenital plate of the female.

Head small, less than half as wide as the pronotum. Crown narrow, elongate, nearly parallel-sided; produced in front of eyes; lateral carinæ strongly elevated. Forehead narrow, nearly parallel-sided to below the antennæ then suddenly flaring to the clypeus; the lateral carinæ strongly elevated nearly contiguous between the eyes. Clypeus elongate, robust; tricarinate. Antennæ short; the second segment about as long as the great diameter of the eye. Pronotum deeply emarginate posteriorly; the lateral flaps large. Mesonotum large, ecarinate; tegulæ large, the posterior margin truncate. Pustules on Sc + R stem large.

General color of the body tawny, more or less clouded with fuscous. Antennæ, cheeks, lateral areas of the mesonotum, apices of the tibiæ, the tarsi and the dorsal crest of the abdomen marked with red. The tegminæ are chiefly pale fuscous with three more or less distinct transverse fasciæ milky subhyaline.

Length to apex of abdomen 4.5 mm.; wing expanse 23.5 mm.

Holotype, female, Barro Colorado, 24 July 1924, N. B.

Paratype, female, Barro Colorado, 17 July 1924, N. B.

Mysidia subfusca spec. nov.

Plate XVIII

This species resembles *pallescens* Metcalf in general color but is structurally distinct. The crown is broadly triangular, not parallel-sided and the subgenital plate is elongate, nearly as long as broad, triangularly, produced not twice as broad as long, not produced as in *pallescens*.

Head small. Eyes large. Crown broad, about one and one half times as long as broad; triangular; the lateral carinæ not strongly elevated. Forehead narrow; the lateral carinæ parallel and nearly contiguous to the lower margin of the eyes and then diverging to the clypeus. Clypeus tricarinate; robust, about as long as the frons. Antennæ elon-

gate, about one and one-half times as long as the great diameter of the eye. Pronotum short, deeply emarginate posteriorly. Mesonotum large, not strongly elevated. Tegulæ triangular, posterior margin truncate. Subgenital plate elongate about one and one-half times as broad as long; produced posteriorly into a broad triangular tooth which is rounded apically.

General color of the body pale tawny. Eyes dark brown. Tegminæ chiefly pale fuscous with indistinct milky subhyaline fascia.

Wing expanse 21.0 mm.

Holotype, female, Barro Colorado, 26 June 1924, N. B.

Mysidia nigropunctata spec. nov.

Plate XVIII

This is one of the smaller species of the genus, with a moderately broad crown and forehead and with a few distinct black points on the medial and cubital sectors. The subgenital plate of the female is broad produced caudad into a broad tooth which has a deep triangular notch.

Crown broad and short, the median length about as long as the width at base; the lateral carinæ not strongly elevated. Forehead broad, the lateral carinæ strongly elevated; the lateral margins concavely curved from apex of crown to clypeus. Clypeus short robust with a very faint median carina. Antennæ short; the second segment about two-thirds as long as the great diameter of the eye; sensory pits wanting. Pronotum elongate, the lateral flaps large with a well developed carina from the lower margin of the eyes to the tegulæ. Mesonotum enlarged; carinæ indistinct. Subgenital plate broad, nearly twice as broad as long, posterior margin produced for one-half the length of the plate into a broad triangular tooth which is deeply notched.

General color of the body pale tawny yellow clouded with pale fuscous. Tegminæ and wings milky subhyaline clouded with pale fuscous especially along the veins and cross veins.

Wing expanse 18 mm.

Holotype, female, Barro Colorado, 27 July 1924, N. B.

Allotype, male, Barro Colorado, 26 July 1924, N. B.

Paratypes, 1 female, Barro Colorado, 25 July, and 1 male, Barro Colorado, 13 July, N. B.

Mysidia nebulosa Germ.

Plates XVII, XVIII

Fowler 1900g: 73.

A single mutilated male Canal Zone, Fort Sherman, 3 July, 1924, N. B., which fits Muir's revised description of this species.

Mysidia obscura spec. nov.

Plate XVIII

This is one of the largest species of the genus with the tegminæ and wings yellowish heavily clouded with fuscous.

General color of the body dull brownish ochraceous with the eyes black. Tegminæ and wings transparent, veins brownish and with the cross veins and the apical margins clouded with fuscous; each of the longitudinal veins of the tegminæ ends in a small oval transparent area.

Crown rather narrow, about twice as long as the basal width, distinctly produced in front of eyes. Forehead narrow nearly parallel-sided but somewhat widened below, the lateral margins pustulate. The median carina of the clypeus not reaching the base. Second segment of antennæ longer than the diameter of the eye. Subgenital plate of female more than twice as broad as long, the median area of the apical margin suddenly quadrately produced.

Wing expanse 28 mm.

Holotype, female, Porto Bello, Panama, 27 Feb. 1911, A. Busck, United States National Museum.

Pseudomysidia gen. nov.

Type *Pseudomysidia fuscovaria* sp. nov.

This genus is closely related to *Mysidia* Westwood. It differs in structure of head and antennæ and in details of wing venation.

Head small; crown reduced; lateral carinæ of head contiguous and continuing around vertex. Antennæ small; antennal collar conspicuous but not strongly elevated; second segment enlarged apically without definite sinus. Tegminæ elongate; branches of media one and two arising dichotomously not apparently arising from cell media one; media with eleven apical branches, the three main sectors of cubitus unbranched.

PSEUDOMYSIDIA FUSCOVARIA spec. nov.

Plates V, XIV, XVIII, XIX

Like a small *Mysidia* with different head structure, characteristic venation and different genitalia.

Head narrow, crown and forehead greatly compressed. Antennæ short; the second segment not as long as the great diameter of the eye. Pronotum elongate deeply but broadly sinuate posteriorly, not excised. Mesonotum large; tricarinate. Tegulæ large. Tegminæ elongate about twice as long as body.

General color of body ochraceous orange; abdomen more testaceous; eyes fuscous; tegminæ and wings milky subhyaline irregularly fasciate with fuscous.

Length to apex of tegmina 8.2 mm.

Holotype, male, Barro Colorado, 15 July 1924, N. B.

Allotype, female, Barro Colorado, 16 July 1924, N. B.

Paratypes, seven males and nineteen females, 15–18 July 1924, N. B.

Tribe OTIOCERINI

This tribe is quite distinct. The head is usually much compressed; the antennæ are frequently much modified; the tegminæ are elongate.

Key to the American Genera of the Tribe OTIOCERINI

A. Subcosta, radius and media forming a common stem from the basal cell with subcosta branching from the stem before media.
- B. Antennæ long projecting beyond the apex of head.
  - C. Media with five main sectors before the submarginal vein. Head not produced .... *Platonax* Metcalf
  - CC. Media with three main sectors before the submarginal vein. Head strongly produced .... *Platocera* Muir
- BB. Antennæ short not projecting beyond the apex of head .... *Heronax* Kirkaldy

AA. Subcosta plus radius and media arising separately from the basal cell or if forming a common stem media branching before subcosta.
- B. First segment of antennæ more than twice as long as broad; antennæ with appendages.
  - C. Head when viewed laterally notched on the dorsal margin and turned up at apex. Genital plates of male with slender hook-like appendages beyond the circular median incision........ *Apache* Kirkaldy

CC. Head not notched on the dorsal margin. Genital plates with broad elongate plate-like processes beyond the circular median notch *1*
  1. Apex of head rounding, not angled above. *Shellenius* Ball
  1. Apex of head angled above . . . . *Otiocerus* Kirby

BB. First segment of antennæ short sometimes broader than long, without appendages.
  C. Second segment of antennæ short . . . . . *Pyrrhoneura* Kirkaldy
  CC. Second segment of antennæ more than three times as long as broad *1*
    1. Tegminæ with costal appendage strongly developed and flap like . . . . *Sayiana* Ball
    1. Costal appendage not developed *2*
    2. Costa broad; transverse veinlets crowded together to give the appearance of a stigma . . . . *Amalopota* Van Duzee
    2. Costa narrow; transverse veinlets not crowded together, usually inconspicuous . . . . *Anotia* Kirby

Platonax gen. nov.

Type *Platonax maculata* spec. nov.

This genus resembles the genera *Phra* Distant and *Heronax* Kirkaldy (equals *Fenuahala* Distant) in venation but the head characters and the antennæ are similar to the genus *Platocera* Muir.

Head narrow nearly circular in outline. Antennæ elongate slightly longer than face; second segment broad and flat, globosely expanded basally. No subantennal processes or shoulder keels. Forehead narrow, keels approximate, gradually diverging dorsally. Crown triangular, the lateral keels strongly elevated. Eyes globose, ventral sinus shallow. Pronotum relatively broad, deeply notched posteriorly, strongly sloping. Mesonotum strongly arched. Tegminæ broad, venation similar to *Heronax* and *Phra*. Subapical line connecting subcostal vein with claval vein conspicuous. Radius not branched before subapical line. Media five branched, the first and fourth branches branching beyond subapical line. Radius and media connected by a strong cross vein. Cubitus two branched. Legs elongate slender.

Platonax maculata spec. nov.

Plates V, XIX

This species may be recognized by the milky subhyaline tegminæ sparsely spotted with fuscous. General color of head and thorax yellowish testaceous, eyes brown.

A conspicuous testaceous yellow species with the tegminæ milky white with a few irregular spots and some of the veins blackish fuscous.

Crown triangular, about one and one-half times as long as basal width, deeply excavated, basal carina conspicuous. Forehead consisting of the strongly elevated carinæ which diverge slightly dorsally. Clypeus as long as forehead slightly shorter than beak. Antennæ conspicuous, longer than forehead, basal segment four times as long as broad; globose at base and then thin and foliaceous. Legs long and slender, pro- and mesothoracic tibiæ and femora subequal. Metathoracic tibiæ nearly twice as long as femora.

Length to apex of tegmina 10.5 mm.

Holotype, male, Barro Colorado, 2 Aug. 1924, N. B. (M.C.Z.)

Otiocerus Kirby

(Kirby 1821a: 13)

Logotype *Otiocerus stollii* Kirby.

Ball has recently (1928b: 196) revived the genus *Apache* Kirkaldy (*Hynnis* Burmeister) and erected the new genus *Shellenius* for *schellenbergii* Kirby and *balli* McAtee. Fowler described a number of species in this genus from Central America most of which Ball has placed in one of the above genera. There are no species of this group in the present collections save *rubescens* Fowler which belongs to the genus *Anotia*.

Among the many trivial criticisms of my key to this genus published in 1923 Ball states that: "Metcalf separated *reaumuri* Kirby from *signoretii* Fitch as "without" the five spots ignoring the fact that Kirby specially described them." The facts are these. My key gives as the character for *signoretii* Fitch, "Fore wings with a large black spot on the sutural margin and four smaller ones in a square." This is an almost direct quotation from Fitch's description (1856a: 394). The contrasting character is "without a large black spot and four smaller ones in a square." This merely means that the black spots are not arranged in this way. I had no intention of ignoring the fact that there were five black spots on the tegmina of *reaumurii* as described by Kirby (1821a: 18) as both Kirby and Fitch describe them. I was simply trying to emphasize the point that Fitch makes, that *reaumurii* and *signoretii* are quite similar but differ in the arrangement of the black spots. Until authentic specimens of *reaumurii* are produced I shall retain the name *signoretii* for the species with the spots arranged as described so aptly by Fitch.

AMALOPOTA Van Duzee

(Van Duzee 1889d: 176)

Haplotype *Amalopota uhleri* Van Duzee.

This genus is close to *Anotia* Kirby. I separate it on the basis of the fact that the costal cell is broader, the costal cross veins are few in number and crowded together at the apex of the costal cell.

AMALOPOTA FITCHI Van Duz.

Plates I, XIX

Van Duzee 1893a: 280.

There is in the present collection a single mutilated female collected on Barro Colorado, 5 July 1923, R. C. Shannon, which seems to agree with this species; and two males Canal Zone, N. B., and one male Panama, 7 July 1924, N. B.

ANOTIA Kirby

(Kirby 1821a: 20)

Haplotype *Anotia bonnetii* Kirby.

The species of this genus are among the most delicate of North American Derbidæ. All the species have very compressed heads, the forehead reduced to a mere keel and the second antennal segment elongate nearly as long as the forehead. The tegminæ are two or more times as long as the body; with subcosta and radius united for about one-third their length; medius with four branches; cubitus one with two branches ending in the extended claval vein. The male genital plates consist of horizontal lamelliform plates usually narrowly ovoid with a vertical ridge on the dorsal surface forming a blunt recurved tooth near the middle.

Five species are known from Eastern North America and five from Central America.

Key to the Known Species of ANOTIA *Kirby*

A. Tegminæ transparent without definite spots or vittae.................. *pellucida* Fowler (Mexico)

AA. Tegminæ more or less marked.

B. Basal segments of the abdomen with a mid-dorsal black stripe.

C. Forewings with three conspicuous black spots; mesonotum black .... *punctata* Metcalf (Canal Zone)
CC. Forewings without conspicuous spots; mesonotum pale ...... *burnetii* Fitch (Eastern United States)
BB. First three segments of abdomen without a mid-dorsal black stripe.
C. Apical border of fore wings with round black spots in cells . . *1*
1. Wings with conspicuous transverse fasciæ *2*
1. Wings without conspicuous transverse fasciæ, markings obscure .... *tenella* Fowler (Mexico)
2. Second joint of antennæ at least three times as long as vertex; basal fascia conspicuous, apical fascia wanting.... *smithi* Fowler (Mexico)
2. Second joint of antennæ slightly longer than vertex; apical cloud conspicuous, basal fascia inconspicuous........... *bonnetii* Fitch (Eastern United States)
CC. Apical border of fore wings without round spots in cells..... *1*
1. Fore wings with a few cross veins marked with fuscous otherwise fore wings pale.......................... *2*
1. Fore wings more or less marked with fuscous *3*
2. Second segment of antennæ at least twice as long as vertex. *marginicornis* Fowler (Guatemala)
2. Second segment of antennæ about as long as vertex..... *robertsoni* Fitch (Eastern United States)
3. All veins of tegmina pale, bordered with smoky......... *westwoodi* Fitch (Eastern United States)
3. Some of veins of tegmina dark *4*
4. Anal segment of male shorter than genital styles, truncate at apex; genital styles from the ventral view acute at apex *kirkaldyi* Ball
4. Anal segment of male longer than genital styles, produced ventrad and notched at apex; genital styles from the ventral view truncate at apex........... *invalida* Fowler
4. All the veins of the tegmina bright red; most of the cells heavily clouded with fuscous .... *rubescens* Fowler

Anotia punctata spec. nov.

Plates V, XVIII, XIX

Resembling *burnettii* Fitch in general structure; differing in color and in the structure of male genital plates.

Head not angularly produced; vertex narrow nearly three times as long as basal width. Antennæ with second segment compressed, thickly and uniformly studded with sensory pits. Pronotum short deeply incised on the median line. Mesonotum large, flat.

General color of the body pale testaceous yellow, eyes, mesonotum largely and dorsum of the abdomen black. Antennæ tinged with brown. Tegminæ and wings milky subhyaline; the tegminæ marked with three large brownish spots one at the apex of the basal third extends from radius across media to cubitus one; a second at the base of the apical third extends across subcosta and radius touching media; the third is less definite covering the branching of media one. There is a smaller spot on the commissural margin near the apex of clavus and an indefinite brownish cloud across vein cubitus one a.

Length of body 3.5 mm.; to apex of tegmina 6.6 mm.

Holotype, male, Barro Colorado, 7 Jan. 1929, C. H. C.

Anotia invalida Fowl.

Plate XIX

Fowler 1904a: 79

Ball 1928b: 197 makes this species synonymous with *A. kirkaldyi* Ball. There is, however, a species with markings similar to what we call *kirkaldyi* but with entirely different genitalia. In *kirkaldyi* (plate XVIII) the genital styles are rather slender acuminate apically with the apices turned dorsad; the anal segment is about half as long as the styles, broad and round apically. In *invalida* the genital styles are broad, obtuse at the apex with a short dorsal tooth; the anal segment is elongate, slender, longer than the styles, the apex produced into two elongate processes.

A single male, Bella Vista, Panama, 7 Aug. 1924, N. B.

anotia rubescens Fowl.

Plate XIX

Otiocerus rubescens Fowler 1900g: 76

The position of this species has been somewhat anomalous. Fowler placed it in *Otiocerus* with doubt. It suggests *Anotia* in some respects but the venation of the tegmina is not exactly like that genus.

This species is somewhat intermediate between *Otiocerus* Kirby and *Anotia* Kirby. Head is intermediate in shape and the wing venation is more like *Otiocerus*. However, the antennæ are simple not vermiculate and the genitalia are different from either genus.

Crown is elongate; forehead narrow linear; outline of head not concentric with margin of eye; antennæ simple, first segment very short,

second segment elongated. Pronotum almost completely excavated posteriorly. Mesonotum large, smooth. Tegminæ large; costal appendage not developed, costal cell narrow a few regular cross veins toward apex of costal cell, subcosta and radius united at base; media with five principal sectors before the ambient vein; cubitus one with two branches before ambient vein, Cu 1a connected to medius by a strong cross vein. Legs simple. Basal abdominal segments compressed, tenth segment elongate as long as genital styles.

The general color is ochraceous orange with the carinæ and the venation of tegmina bright red. The tegminæ are faintly clouded with fuscous.

A single male, Porto Bello, 15 Feb. 1911, A. Busck.

Tribe CENCHREINI

This is an extensive tribe with numerous genera and species from all parts of the world. The chief distinctive character seems to be the fact that the claval veins unite to form a claval stem which ends before the apex of clavus; and that the first cubital sector is simple or bifurcate ending in the apical margin of the tegmina.

The chief generic characters are furnished by the presence or absence of a subantennal process on the cheeks, by the presence or absence of antennal foveæ on the pronotum with strongly developed dorsal and ventral keels, on the lateral fields of the pronotum behind the antennæ, and by the venation of the tegminæ, especially the arrangement of the subcostal-radial stem, with reference to the stem of media and the branching of media and cubitus; the relative length of subcostal cell; and whether the claval veins are granulate or not.

In the past there has been very much confusion in the various genera without any very clear concept of generic limits or generic characters. The older genera have been redescribed and synonymized without access to the types and in numerous instances without study of the descriptions or illustrations. I plead guilty to having done my share of this in the past. In the present paper I am retaining all past generic names of American genera, but I am not sure that the characters used are valid. I have not seen the type species for any of the genera except *Cedusa* Fowler and *Neocenchrea* Metcalf. The illustrations of the types of *Patara* Westwood, *Syntames* Fowler, *Cyclokara* Muir, *Cenchrea* Westwood, *Dysimia* Muir, *Symidia* Muir, *Phaciocephalus* Kirkaldy and *Basileocephalus* Kirkaldy are sufficient to establish these genera it seems to me. However many species have been assigned to these genera with-

out careful consideration of their characters or without any consideration of zoogeographic distribution. Hence I am not sure of the real position of some of these species. The following genera seem to be fairly distinctive and the included species seem to be accurately placed. *Persis, Syntames, Neocenchrea, Dysimia* (monotypical) and *Symidia* (monotypical). I am very doubtful in the following cases: *Patara* with species from St. Vincent Island and Eastern North America including *Aquælicium* with species from the Seychelles Islands; both genera have elongate antennæ but I believe the venation is distinct. *Cyclokara sordidulum* is somewhat anomalous in *Dawnaria* where the typical species of *Cyclokara, C. girdlestoni* seems to belong. I am doubtful about our North American species *fulva, mcateei,* and *uhleri* belonging to the genus *Cenchrea. C. dorsalis,* the typical species, has according to the illustration a short subcostal cell, a short furcate first cubital sector and a characteristic arrangement of the branches of media. Our North American species have an elongate subcostal cell; a distinct discal cell from which the branches are continued in a pectinate manner to the apical border; and a deeply furcate first cubital sector and are best placed in *Syntames.* The genus *Phaciocephalus* as it now stands seems to be a composite of East Indian, Papuan, Polynesian, West Indian and Neotropical species. It will require a thorough restudy of all the species to determine their true status. The inclusion of *Mysidia spreta* in *Basileocephalus* should be reviewed. *Herpis* is perhaps a composite with two species from South America, one from Formosa, one from India, one from Borneo and three from the Philippines. Muir states that one of his species from the Philippines has a subantennal process on the cheeks and shoulder keels on the pronotum. On this basis I have included it in the key although Stål does not mention this character in the original description and Muir's statement that *Herpis* and *Syntames* are synonymous may be correct and the East Indian species may belong elsewhere.

Key to American Genera of the Tribe CENCHREINI

A. Subantennal process on cheeks well developed.
  B. Pronotum without antennal fovea .... *Cedusa* Fowler
  BB. Pronotum with well developed antennal fovea .... *Herpis* Stål
AA. Subantennal process on cheeks absent or very small.
  B. Pronotum with well developed antennal fovea.
    C. Forehead linear, the lateral carinæ contiguous to near apex... *Symidia* Muir

CC. Forehead not linear, the lateral carinæ not contiguous *1*
1. Subcostal-radial stem, media and first cubital sector distinctly bifurcate . . . . *Neocenchrea* Metcalf
1. Subcostal-radial stem, media and first cubital sector not distinctly bifurcate *2*
2. First claval vein distinctly granulate *3*
2. First claval vein not granulate . . . *Phaciocephalus* Kirkaldy
3. Radius branching from the stem close to the branching of media; subcostal-radial stem short, subcostal cell long . . . . *Syntames* Fowler
3. Radius not branching from the stem close to media; subcostal-radial stem long, subcostal cell short . . . . *Cenchrea* Westwood

BB. Pronotum without antennal fovea.
C. Vertex meeting forehead at an angle . . . . *Persis* Stål
CC. Vertex rounding into forehead *1*
1. Antennæ flattened, elongate reaching beyond apex of head *Patara* Westwood
1. Antennæ shorter than frons *2*
2. Subcosta, radius and media forming a common stalk on basal fifth of tegmina; media with seven apical veins . . . . . *Dysimia* Muir
2. Media barely united with the stem of subcosta and radius at the basal cell; media with five branches . . . . *Dawnaria* Distant

Persis Stål

(Stål 1862e: 7)

Haplotype *Persis pugnax* Stål.

We consider this genus as distinct as many other genera in the Homoptera, hence we have retained it. Stål (1869a: 99) places *Cicada lineata* Fabricius (1803a: 66) in *Persis*. McAtee (1924b: 178) places it in *Cenchrea* Westwood. The type should be reexamined and its true location determined. In any event the name *Cicada lineata* Fabricius 1803 is preoccupied by *Cicada lineata* Linné (1761a: 241), now *Philæneus lineata* Linné. I propose *Persis fabriciana* for *Cicada lineata* Fabricius.

Persis fuscinervis Muir

Plates I, V, XVIII, XIX

Muir 1918a: 417.

This species was originally described for a single female from British Guiana. We have a series of three females and two males from Ancon,

Red Tank, and Ft. Sherman, Canal Zone which seem to agree in all essential details with Muir's description.

The male genital styles are robust, elongate with the apices recurved and excavated ending in rather acute tips. The aedeagus is elongate about one and one-fourth times as long as the styles. The anal segment is elongate slender about one and one half times as long as the styles. The anal spines are short triangular incurved, with the acute apices approximate on the median line.

Cedusa Fowl.

(Fowler 1904c: 112)

Logotype *Cedusa funesta* Fowler, Muir 1913c: 35.

There has been much confusion in the use of the generic names *Herpis* Stål, logotype *Herpis fuscovittata* Stål, *Lamenia* Stål, haplotype *Delphax caliginea* Stål, and *Cedusa* Fowler, logotype *Cedusa funesta* Fowler. Muir has established the genotypes as indicated. According to this definition *Herpis* has well developed lamelliform subantennal processes on the cheeks and well developed antennal foveæ on the lateral margins of the pronotum. *Cedusa* has the subantennal processes and a single dorsal lamelliform carina on the lateral field of the pronotum and *Lamenia* has the foveæ and no subantennal process. If this definition is correct, all our common North American species belong in *Cedusa*.

Cedusa funesta Fowl.

Plate V

Fowler 1904c: 112.

There is a series of five specimens from Barro Colorado, Cristobal and Mt. Hope which I presume is this species. They are dull black in color with the tegminæ and wings smoky. The characters of the head and thorax are well shown in the illustrations.

Syntames Fowl.

(Fowler 1905a: 138)

Haplotype *Syntames delicatus* Fowler.

This genus can be recognized by the broad nearly parallel-margined crown and forehead, pronotum with a distinct antennal fovea; tegminæ

broad; subcostal cell long; there is a distinct discal cell from which the five or six branches of media arise; cubitus bifurcate before the level of the union of claval veins.

If my identification of *delicatus* is correct our common North American species, *fulva* Van Duzee, *uhleri* Ball, and *mcateei* Dozier, belong here and not in *Cenchrea* Westwood. This genus would also include *Cenchrea brunnea* McAtee.

Key to the Known Species of SYNTAMES *Fowler*

A. Tegminæ light ochraceous buff with a more or less regular and more or less complete oblique fascia from claval suture to apical angle.
- B. Genital styles, viewed ventrad, broad and obtuse at apex.
  - C. Genital styles, viewed laterad, with the dorsal edge suddenly produced near base and then straight to apex............. *delicatus* Fowler
  - CC. Genital styles, viewed laterad, with the dorsal edge triangularly produced at the middle........................... *chiriquensis* Fowler (Central America, British Guiana)
- BB. Genital styles, viewed ventrad, sublanceolate and curved........ *sufflavus* Muir (British Guiana)

AA. Tegminæ variously colored usually white, testaceous or fuscous without oblique fascia.
- B. Tegminæ milky white........................*albidus* Metcalf
- BB. Tegminæ dark, fuscous or testaceous.
  - C. Lateral margins of the crown strongly elevated...........*1*
    1. Size small, 3.5 mm. to 4.0 mm............*mcateei* Dozier
    1. Size larger, 5.0 mm. to 6.5 mm.........*fulvus* Van Duzee
  - CC. Lateral margins of the crown not strongly elevated........*1*
    1. Tegminæ stramineous with dark costal and commissural streaks..................................*uhleri* Ball
    1. Tegminæ dark without definite streaks...............*2*
    2. Forehead distinctly widened below..... *brunneus* McAtee
    2. Forehead parallel-sided..................*fuscus* Metcalf

SYNTAMES DELICATUS Fowl.

Plates I, XIX, XX

Fowler 1905a: 139.

The general appearance and the character of the genitalia are shown by the illustrations.

The head is ochraceous orange, with eyes fuscous; and the tegminæ light ochraceous buff, with a distinct fuscous oblique fascia extending

from the forking of the first cubital sector to the apical angle; there is a more or less distinct fuscous vitta along the first claval vein; a distinct fuscous spot beyond the apex of clavus; and a small fuscous spot on the base of the costal margin.

There is a rather extensive series in the present collection from Barro Colorado Island various days, July 1924, N. B.

SYNTAMES FULVUS Van D.

Plates V, XX

Cenchrea fulva Van Duzee 1909a: 195.

Dozier has recently (1928a: 128) separated the smaller species *mcateei* 3.5 — 4.0 mm., from the larger *fulvus* 6.5 mm. Five females from Barro Colorado are intermediate in size 5.0 — 5.5 mm., but otherwise agree with the general descriptions of *fulvus* or *mcateei*. The pregenital plate of the female is elongate, whereas in the smaller *mcateei* from North Carolina the pregenital plate is short and broad. In *mcateei* the basal hooks of the genital styles of the male are near the base, whereas by inference they are near the middle of the styles in *fulvus*.

SYNTAMES BRUNNEUS McA.

Plate XX

Cenchrea brunnea McAtee 1924b: 178.

This species was described from Mexico, Canal Zone and Guatemala. There is a series of five females from Barro Colorado which agree in all essential details except size, 5.5 mm. to 6.0 mm. The pregenital plate of the female is elongate with the terminal flap short and broad. The forehead is distinctly widened below.

SYNTAMES FUSCUS spec. nov.

Plate XX

This species is close to *brunneus* McAtee but differs in having a shorter broader crown, a broad parallel-sided forehead and distinct genitalia.

Crown short and broad, nearly twice as broad as long, the lateral margins not elevated. Forehead broad, nearly parallel-sided throughout; the lateral margins slightly elevated, coarsely granulated. Clypeus

elongate, broad at base, triangular, with strong median and lateral carinæ, nearly flat between the carinæ. Pronotum rather long; antennal foveæ large, deep. Mesonotum tricarinate.

Male: Last ventral segment about as broad as long with a long median tooth; genital styles long, narrow without basal tooth, the inner margins widely separated basad, then converging gradually to the apical third then diverging and curving dorsad to the acuminate apices. Viewed laterad, the styles are slender basad, widening dorsad in an obtuse triangular tooth, the apex slender and ending in a long slender spine which is directed dorsad; the anal segment is slender basad widened toward the apex, ending in a pair of elongate acute teeth.

The female pregenital plate is broad and short nearly three times as broad as long with an elongate truncate flap.

Length to apex of tegmina 7.0 mm.

Holotype, male, Barro Colorado, 19 June 1924, N. B.

Allotype, female, Barro Colorado, 19 June 1924, N. B.

Syntames albidus spec. nov.

Plates VI, XX

This is a small pale species with white tegminæ and a broad pregenital plate with a large flap.

Crown longer than broad, lateral margins but little elevated with a double row of punctures. Apical margin triangularly produced. Forehead broad, lateral margins straight and parallel, median carina strongly elevated dorsad. Clypeus short about half as long as forehead. Pronotum rather short, the antennal foveæ large, deep. Tegminæ rather short and broad.

Female pregenital plate broad and short more than twice as broad as long. Flap large constricted basad nearly circular in outline.

General color of head, thorax, legs and abdomen pale ochraceous buff; more or less covered with white wax. Eyes brown. Tegminæ and wings white, venation concolorous.

Length to apex of tegminæ 6.0 mm.

Holotype, female, Barro Colorado, 18 July 1924, N. B.

Paratype, female, Barro Colorado, 12 July 1924, N. B.

NEOCENCHREA Metc.

(Metcalf 1923a: 193)

Orthotype *Cenchrea heidemanni* Ball.

McAtee (1924b: 177) reduces this genus along with *Herpis* Stål and *Syntames* Fowler to synonymy with *Cenchrea* Westwood. We cannot agree with this, however, as the venation, the genitalia and other characters are fundamentally different and to lump these distinct groups together simply makes generic characters so broad and general as to be meaningless, and raises them to the rank of a subtribe or even a tribe. Such lumping is a distinct disservice in systematics for it does not permit natural grouping of related species without the cumbersome use of subgenera and its only function for the general zoologist is to enable him to use a generic name instead of the name of a tribe or subtribe when discussing problems of morphology, physiology, ecology, et cetera.

This genus may be distinguished by the following characters: Head narrow with narrow crown and forehead, both of which have strongly elevated lateral margins and are without a median carina. Antennal foveae on pronotum strongly developed. Tegminæ long and narrow; three main veins of corium bifurcate; radius separated from subcosta before the level of the apex of clavus, media branched just beyond apex of clavus and first cubital sector branching at about same level as the union of claval veins.

This genus is close to *Basileocephalus* Kirkaldy, which includes *Urabunna* Distant, with one species from Morty and one from Queensland. Muir has placed *Mysidia spreta* Fowler from Mexico in *Basileocephalus* but it probably belongs to this genus, if the two genera are to be kept separate.

Key to the Species of NEOCENCHREA *Metcalf*

A. Crown broad, truncate caudad, strongly converging anteriorly.
 B. Tegminæ with dusky dots in the apical cells.................... *bakeri* McAtee 1924b: 177 (Mexico)
 BB. Tegminæ without dusky dots.................... *pallida* Metcalf
AA. Crown narrow, angulate caudad, not strongly converging anteriorly.
 B. Forehead nearly parallel-margined............ *pallescens* Metcalf
 BB. Forehead distinctly narrowed between the eyes................. *heidemanni* Ball 1902d: 261 (United States)

Neocenchrea pallida spec. nov.

Plates VI, XX

This species resembles a small *N. heidemanni* Ball, the tegminæ are narrower and more pointed; the crown is broader, and the main sectors of media are more deeply bifurcated.

Crown of head broad, triangular, posterior margin straight, lateral margins strongly elevated, pustulate; forehead narrow, lateral margins strongly elevated, pustulate, somewhat widened below; clypeus tricarinate. Pronotum rather broad, tricarinate, the lateral carinæ sinuate; posterior border broadly sinuate; shoulder keels strongly elevated. Mesonotum broader than long; distinctly tricarinate, the carinæ parallel; apex depressed.

Female subgenital plate, produced caudad, the apex truncate and minutely serrulate.

General color ivory white, the tegminæ testaceous yellow, eyes rosy red.

Length 6.5 mm. to apex of tegminæ.

Holotype, female, Barro Colorado, July 1923, R. C. Shannon.

Neocenchrea pallescens spec. nov.

Plates I, VI, XX

Similar to *N. pallida* Metcalf but with a narrower, nearly parallel-sided crown; a relatively broader and shorter forehead and different genitalia.

Crown as long as broad at the base; deeply incised posteriorly; the lateral margins strongly elevated and granulate. Forehead longer than clypeus; the lateral margins strongly elevated and parallel-margined. Antennæ very short. Pronotum about half as long as crown; deeply incised posteriorly with anterior and posterior margins parallel; antennal foveæ large, deep. Mesonotum broad; obscurely tricarinate. Tegminæ elongate, narrow. Subgenital plate of female broad, triangular acuminate caudad.

General color of head, thorax, legs and abdomen ochraceous buff; with the mesonotum, crown and forehead shading to ochraceous orange; eyes and edges of frontal carinæ brown. Tegminæ white, slightly tinged with buff.

Length to apex of tegminæ 6.8 mm.

Holotype, female, Barro Colorado, 19 July 1924, N. B.

Allotype, female, Barro Colorado, 20 July 1924, N. B.

Family ACHILIXIIDÆ

This small family consists of two genera one, *Achilixius* Muir with four species from Borneo and the Philippines; the other, *Bebaiotes* Muir with two species from Ecuador.

Superficially the members of this family resemble certain species of *Cixiidæ* but the general characters are more nearly like the species of *Achilidæ* but with steeply tectiform tegminæ and with appendages on the basal segments of the abdomen.

Muirilixius gen. nov.

Type *Muirilixius banksi* spec. nov.

This is the second American genus of this small and interesting family. It is close to *Bebaiotes* Muir but differs in that the frontal carinæ are contiguous, and it differs fundamentally in wing venation.

Head narrow, crown narrow, triangular, the lateral margins converging and meeting anteriorly, base broadly emarginate; forehead reduced to the contiguous carinæ to near the base then widened suddenly to the clypeus; clypeus elongate nearly as long as frons, carinate. Antennæ elongate; antennal sockets strongly elevated; first segment nearly as long as broad; second segment about twice as long as first. Lateral ocelli conspicuous. Eyes deeply emarginate ventrally. Pronotum elongate, nearly as long as mesonotum; the disc strongly elevated, with lateral carinæ evident, median carina sometimes indistinct. Mesonotum tricarinate.

The venation of the tegminæ is characteristic. Radius is unbranched. Media arises from radius and branches into two main sectors; first sector united with radius by a strong cross vein close to its point of origin; first sector deeply furcate; second sector shallowly furcate. First cubital sector branches on a level with media.

Muirilixius banksi spec. nov.

Plates II, VI, XVI, XIX

General color of the body, legs and antennæ testaceous yellow. Segments of the abdomen clouded with fuscous. Tegminæ testaceous yellow; thrice banded with fuscous, the first at the apex of the basal third, the second beyond the apex of clavus, the third near the apex, the first connected with the second by a fuscous vitta sometimes ex-

tending along the costal margin to the base; the second and third fasciæ connected by an indefinite cloud over the central area.

Body slightly compressed; tegminæ tectiform; crown four or five times as long as basal width, shading imperceptibly into forehead; pronotum rather large, broadly incised posteriorly; mesonotum large, about as long as head and pronotum combined.

Male genitalia very small deeply inserted into the abdomen. Pygofer small, entire; anal segment small; anal style inserted, minute; genital styles small spine-like, outer margins concentric with margins of pygofer.

Length to apex of tegminæ 7.3 mm.

Holotype, female, Barro Colorado, 18 August 1924, N. B.

Allotype, male, Barro Colorado, 20 August 1924, N. B.

Paratypes, one female, 13 August; two females, 18 August; one male, 18 August; all Barro Colorado.

Family DICTYOPHARIDÆ

This family contains some of the most bizarre forms of Fulgorids. The head is frequently produced into an elongate cephalic process; the tegminæ are macropterous, transparent, with distinct venation in some genera; while in other genera they are koelopterous, without a claval furrow and venation reduced or indistinct.

Key to Subfamilies and Tribes of DICTYOPHARIDÆ

(Modified from Melichar)

A. Claval furrow present; tegminæ transparent. Tegulæ present......... Subfamily DICTYOPHARINÆ

- B. First claval (first anal) vein united to claval furrow (cubitus two) by a cross vein......................Tribe DICHOPTERINI
  - C. Veins of the tegminæ setigerous........................ Subtribe CLADODIPTERINA
    (A single genus *Cladodiptera* Spinola in the Neogæan Realm)
  - CC. Veins of the tegminæ not setigerous...................... Subtribe DICHOPTERINA
    (No representatives in the Americas; *Rotunosa* Dist. placed here by Melichar belongs to the Family TROPIDUCHIDÆ)
- BB. No cross veins in the clavus..........Tribe DICTYOPHARINI

AA. Claval furrow absent; tegminæ opaque; tegulæ absent................ Subfamily ORGERIINÆ

Key to the North and South American Genera of the Tribe DICTYOPHARINI

(Modified from Melichar)

A. Crown of head usually longer than broad, always distinctly separated from forehead; frequently produced into a distinct cephalic process.

B. Crown of head triangularly produced, or the process conically produced not suddenly constricted in front of eyes.

C. Pronotum and face granulate
Chondrodera Melichar 1912a: 157

CC. Pronotum not granulate *1*

1. Tegmina with reticular network between the principle longitudinal veins on both corium and clavus . . . .
Plegmatoptera Spinola 1839a: 283

1. Cross veins on corium simple, no cross veins on clavus . . *2*

2. Tegulæ with distinct carina *3*

2. Tegulæ without carina *5*

3. Media and first cubital sector of tegmina distinctly branched before the cross veined apical areas *4*

3. Media only branched before the cross veined apical area .
Nersia Stål 1862e: 62

4. Posterior tibiæ with seven spines . . . .
Megadictya Melichar 1912a: 64

4. Posterior tibiæ with only four spines . . . .
Pteroplegma Melichar 1912a: 66

5. The entire corium with cross veins . . . .
Melicharoptera nom. nov. for *Dictyoptera* Melichar 1912a:77 [nec *Dictyoptera* Latreille 1829].

5. Cross veins on the apical third of the corium only . . . .
Dictyophara Germar

BB. Crown of head produced into a definite cephalic process, constricted in front of eyes.

C. Fore tibiæ markedly longer than femora making the fore legs especially long *1*

1. Cephalic process short; fore femora not toothed . . . .
Igava Melichar 1912a: 47

1. Cephalic process elongate *2*

2. Fore femora toothed at apex . . . . . *Dictyopharoides* Fowler

2. Fore femora not toothed at apex . . . .
Lappida Amyot and Serville

CC. Fore tibiæ not especially longer than the femora *1*

1. Pronotum inflated . . . . *Sicoris* Stål 1866a: 151

1. Pronotum not inflated; when viewed from the side crown, pronotum and mesonotum in the same plane *2*

2. Tegminæ transparent *3*
2. Tegminæ leathery not transparent . . . .
Scolops Schaum 1850a: 68
3. Crown suddenly constricted in front of the eyes *4*
3. Crown not suddenly constricted in front of the eyes *5*
4. Lateral carinæ of the vertex when viewed laterally curved, concentric with the margin of the eyes . . . .
Toropa Melichar 1912a: 80
4. Lateral carinæ of the vertex when viewed laterally straight not curved . . . . *Paralappida* Melichar 1912a: 89
5. The dorsal and lateral fields of the cephalic process convex
Dorimargus Melichar 1912a: 90
5. The dorsal and lateral fields of the cephalic process flat or concave *6*
6. Cephalic process robust . . . *Parahasta* Melichar 1912a: 108
6. Cephalic process slender. . . . *Eudictya* Melichar 1912a: 113

AA. Crown of head broader than long, often curving imperceptibly into forehead, no cephalic process.
B. Fore femora compressed.
C. Fore tibiæ broadly widened. . . *Phylloscelis* Germar 1839a: 191
CC. Fore tibiæ simple . . . . *Sicorisia* Melichar 1912a: 29
BB. Fore femora and tibiæ not widened.
C. Forehead with three parallel carinæ
Taosa Distant 1906n: 355
CC. Forehead with two parallel carinæ *1*
1. Tegminæ with two rows of cross veins apically . . . .
Hydriena Melichar 1912a: 50
1. Tegminæ with a single row of cross veins apically . . . .
Parahydriena Muir 1924g: 464

Lappida Amyot and Serville

(Amyot and Serville 1843a: 505)

Haplotype *Dictyophara proboscidea* Spinola.

This genus may be recognized by the elongate, slender cephalic process which is usually expanded apically. The tegminæ are transparent with supernumerary longitudinal veins but not many cross veins; the stigma usually brightly colored with three or four cells. The anterior tibiæ are elongate, longer than the femora; the hind tibiæ have four or five spines.

There are fourteen species known from Mexico, Central and South America. The present study adds two apparently new species.

Key to the Central American Species of the Genus Lappida *Amyot and Serville*

A. Apex of cephalic process with a shining black hemispherical callosity.
- B. Intermediate carinæ of the forehead marked with black on the upper third at least. Length to apex of tegminæ 25 mm. or more........ *ferocula* Distant
- BB. Intermediate carinæ of the forehead not marked with black. Length to apex of tegminæ not more than 20 mm...................... *gracilis* Melichar 1912a: 85 (Nicaragua)

AA. Apex of cephalic process without a callosity.
- B. Cephalic process short robust, about as long as pro- and mesonotum combined.
  - C. Intermediate carinæ of forehead on the upper half completely black.. *1*
    - 1. Pronotum with a transverse row of fine black points..... *fusca* Metcalf
    - 1. Pronotum without a transverse row of black points...... *chlorochroma* Walker (Mexico)
  - CC. Intermediate carinæ not marked with black .... *lappidaoides* Melichar 1912a: 88 (Mexico)
- BB. Cephalic process elongate slender, longer than pro- and mesonotum combined.................................*rubrovittata* Metcalf

Lappida ferocula Dist.

Plate VI

Lappida rubella Melichar 1912a: 84. Distant 1887d: 40; Pl. 6, Figs. 2, 2a.

This species was described as a *Dictyophara* but the illustration plainly shows a species of *Lappida*. This genus was ignored by Distant. Melichar 1912a: 95, credits *ferocula* to Fowler and places it in the genus *Dictyopharoides* which he credits to Distant as of 1887. This part of the Biologia was not published until 1900, however, and the context clearly shows that it was described by Fowler. The genus *Dictyopharoides,* however, has the cephalic process elongate slender tapering not expanded at apex. Having assigned *ferocula* to *Dictyopharoides* Melichar redescribes a reddish color variety as *rubella*.

Ferocula may be recognized from other species of *Lappida* known to me by its large size, 25 mm. or more to the apex of tegminæ; by the elongate slender cephalic process, which is twice as long as pro- and mesonotum combined, with a distinct hemispherical elevation on the widened apex.

Six specimens, all females, Barro Colorado, June, July and August, N. B. and November and January, H. F. Schwarz.

Lappida rubrovittata spec. nov.

Plates VI, XX

This species is close to *L. stratiotes* Gerstæcker from Brazil but differs in certain essential points and until *stratiotes* is completely described I prefer to list it as a distinct species. In contrast to *stratiotes* the following points should be noted: There is no black line on the dorsal surface of the cephalic process. There is no shining black spot at the apex of the cephalic process. The legs have the three femora ringed with black distally and the fore and middle tibiæ are blackish on the distal half. The size is much smaller and the cephalic process relatively shorter.

Cephalic process longer than pro- and mesonotum combined; the dorsal area nearly parallel-sided; no callosity at apex; the widened apical portion formed by the curving of the lateral carinæ; frontal area of the cephalic process very narrow; lateral margins broad, well elevated; intermediate carinæ continued on the frons to the clypeal suture. Clypeus with median and lateral carinæ.

General color testaceous, paler beneath. Carinæ of cephalic process black, dorsal and frontal areas fuscous, lateral areas bright red; margins of pronotum black, a transverse row of small black dots behind carinæ of pronotum, two elongate black dashes on either side of median carina of mesonotum. Legs testaceous with a black ring at the apex of each femur and the distal third of the fore and middle tibiæ and all the tarsi clouded with fuscous. Tegminæ and wings glassy, faintly tinged, stigma bright red, with three or four elongate cells; apical margin clouded with fuscous. Abdomen yellowish testaceous, darker testaceous above with the third and fourth, and the sixth and seventh segments marked with large quadrate black spots.

Length to apex of tegminæ 20.5 mm.

Holotype, male, Barro Colorado, 26 July 1924, N. B.

Allotype, female, 30 December, C. H. C.

Paratypes, 2 males, 24 and 17 July 1924, N. B.

Lappida fusca spec. nov.

Plates VI, XX

This is one of the smaller species of the genus resembling *L. cayennensis* Melichar from French Guiana but smaller with different coloration and with a short, robust cephalic process.

Cephalic process about as long as pro- and mesonotum combined,

the dorsal carinæ straight and nearly parallel from in front of eyes to near the apex; the lateral carinæ distinctly widened apically.

General color ochraceous orange or greenish yellow, with the body and legs and carinæ heavily marked with black. The lateral margin of the cephalic process has a narrow black vitta extending about half way to apex. There is a heavy vitta from the eyes to the tegulæ; another across the clypeus and pleural pieces to the base of the hind wings and a third across the labrum and pleural pieces to the base of the abdomen. The fore femora are thrice ringed with black and the middle and hind femora are ringed with black at base and apex. The tegminæ have the stigma and apex infuscated; the stigma typically with five cells. The abdominal segments are heavily fasciate with black ventrally and slightly dorsally.

Length to apex of tegminæ 18.2 mm.

Holotype, male, Barro Colorado, 29 July 1924, N. B.

Allotype, female, Barro Colorado, 23 June 1924, N. B.

Paratypes, 1 male, Barro Colorado, 24 June 1924, N. B.; 1 female, Barro Colorado, 29 December 1928, C. H. C.; 1 male, Barro Colorado, 25 June 1933, Hood and Hook.

Lappida chlorochroma Walk.

Plate VI

Dictyophora [sic] *chlorochroma* Walker 1851a: 311.

As I identify this species it is a medium small species with a short robust cephalic process which is not much expanded apically; the lateral carinæ of the crown are black apically; and the cephalic process is marked with red laterally; the intermediate carinæ of the forehead are black on the upper third and the ocular process is black.

Dictyophara Germar

(Germar 1833a: 175)

Logotype *Fulgora europaea* Linné, Van Duzee 1916a: 78.

This genus is of world wide distribution. Many species have been included which belong perhaps to other genera.

Key to Central American Species of Dictyophara *Germar*

(Modified from Melichar)

A. Crown distinctly produced, its median length greater than the basal width . . . . Subgenus *Dictyophara* Germar

B. Lateral margins of the forehead visible from above.
C. Tegminæ with the cross veins punctate ....
truncata Walker 1851a: 316 (South and Central America)
CC. Cross veins not punctate *1*
1. Lateral carinæ of crown nearly parallel. Stigma with four cells .... *brachyrhina* Walker (Colombia, Guatemala)
1. Lateral carinæ of the crown converging anteriorly; stigma with three cells ....
obtusifrons Walker (South and Central America)
BB. Lateral margins of the forehead not visible from above ....
platyrhina Walker 1851a: 311 (Brazil, Panama)
AA. Crown as wide as, or wider than, the median length ....
Subgenus *Cuernavaca* Kirkaldy 1913a: 14 (Orthotype *Fulgora herbida* Walker).
B. Crown with a median percurrent carina; the intermediate carinæ of forehead concolorous. *herbida* Walker (South and Central America)
BB. Crown triangularly impressed basad, median carina short; the intermediate carinæ of the forehead black dorsad...............
nigronotata Stål (Mexico, Central and South America)

Dictyophara nigronotata Stål

Plates VI, XX

Stål 1862e: 65.

Three specimens, Barro Colorado, N. B.

This species on the basis of head characters is somewhat anomalous in the genus *Dictyophara*, subgenus *Cuernavaca* Kirkaldy, but the phallic characters are similar and I prefer to retain it in this composite genus for the present.

Vertex shorter than basal width, curvingly transversely impressed with short basal carina; intermediate carinæ of frons black dorsad; stigma concolorous with three cells.

Dictyophara herbida Walk.

Plate VII

Walker 1851a: 306.

A single female specimen from Panama, Las Sabanas, 7 July 1924, N. B.

This is another short headed *Dictyophara* with the vertex as long as broad and a distinct median carina from base to near apex; the intermediate carinæ of frons are tinged with reddish ochraceous, while the median carina is bright green at base; the ovipositors and plates are very short.

Dictyophara brachyrhina Walk.

Plate VII

Walker 1851a: 317.

This species was described from Colombia and is also known from Guatemala. There are a number of specimens in the present collections from Barro Colorado collected by Mr. Banks and Dr. Curran.

This species may be recognized by the broad cephalic process which is about twice as long as broad and nearly parallel-sided. Most of the specimens are dull ochraceous orange but a few have the carinæ and the veins of the tegminæ bright grass green.

Dictyophara obtusifrons Walk.

Plates VII, XXI

Walker 1851a: 318.

There are numerous specimens from Barro Colorado which agree with Melichar's description and Fowler's figure of this species. It may be recognized by its short obtuse crown with the lateral carinæ converging anteriorly. It averages smaller than *brachyrhina,* 15–16 mm. to apex of tegminæ.

Dictyopharoides Fowler

(Fowler 1900e: 44)

(*Paramisia* Melichar 1912a: 79)

Haplotype *Dictyopharoides tenuirostis* Fowler.

Melichar misinterpreted this genus, placing *Dictyophara ferocula* Distant in it and then redescribing this genus as *Paramisia.* Melichar's species of *Dictyopharoides* will have to be restudied but they perhaps belong to *Lappida.* As far as I can judge his species *Paramisia suturata* from Paraguay is a valid species of *Dictyopharoides.*

This genus may be characterized as follows: Crown elongate, produced in front of eyes, then suddenly constricted and produced as a thin compressed upturned cephalic process; cheeks produced in front of eyes, with a large ovoid callosity; anterior tibiæ longer than femora and trochanters combined; anterior femora triangularly expanded distally with four or five minute teeth on the edges of the expanded area; hind tibiæ with four spines; tegminæ elongate; radial, medial and cubital stems branching at about the level of the apex of clavus; claval veins united on the basal third of clavus, abdomen strongly depressed.

Dictyopharoides tenuirostris Fowl.

Plates VII, XV

Fowler 1900e: 44.

There is a single female in the National Museum collection from Buena Ventura, Panama, 10 March 1911, A. Busck. It is testaceous yellow heavily marked with black as follows: Dorsal and ventral margins of the cephalic process; genal callosities; pleural pieces of the pro-, meso-, and metathorax; and the lateral margins of the abdomen both dorsad and ventrad. The tegminæ are transparent save a broad fuscous vitta extending from the apex of the clavus to the apical margin of the tegmina.

Cladodiptera Spinola

(Spinola 1839a: 316)

Haplotype *Cladodiptera macrophthalma* Spinola

This genus has a wide distribution in the Caribbean and Neotropical Regions. Several species were described by Distant from Mexico and Central America but there are no specimens of any of these in the present collection.

Family FULGORIDÆ

This family comprises some of the largest and most conspicuous members of the Fulgorids. Numerous genera and species occur in the tropical regions of the world but they have been little studied since the time of Stål.

The head is frequently much modified often with a distinct, and sometimes with an enormous, cephalic process; the clypeus is carinate on the sides; the tegminæ are usually large with numerous supernumerary longitudinal veins and numerous cross veins; the anal area of the hind wings is reticulate.

Key to the Subfamilies and Tribes of the FULGORIDÆ

A. With a single straight transverse carina between the forehead and crown No cephalic process........................Subfamily PHENACINÆ

AA. With a double carina between forehead and crown, or the head produced into a distinct process.

B. With a vertical carina or a distinct spine in front of eyes.

C. Cephalic process always present, porrect . . . . Subfamily FULGORINÆ

1. With a distinct tooth on the vertical carina in front of eyes. Tribe FULGORINI
1. Carina in front of eyes simple, not toothed *2*
2. Clypeus shallowly inserted in forehead; vertical carina in front of eyes straight . . . . Tribe LATERNARIINI
2. Clypeus deeply inserted in forehead; vertical carina in front of eyes arched . . . . Tribe ZANNINI

CC. Cephalic process, if present, erect, recurved, or appressed, its lateral margins formed by the continuation of the intermediate carinæ of the forehead; if absent the intermediate carinæ of the forehead continued, converging on the crown . . . Subfamily APHANINÆ

1. Pronotum tectiform . . . . Tribe ENCHOPHORINI
1. Pronotum flat with a weak median carina or none . . . . Tribe APHANINI

BB. Without a vertical carina or spine in front of eyes.

C. With a distinct groove between forehead and crown . . . . Subfamily POIOCERINÆ

1. Tegminæ with costal area broad, reticulate, distinctly sinuate towards apex . . . . Tribe PARALYSTRINI
1. Tegminæ with costal area narrow *2*
2. Pronotum with a conspicuous tooth behind each eye . . . . . Tribe LYSTRINI
2. Pronotum not toothed *3*
3. Forehead elongate, narrowed above, reflexed on the produced crown . . . . Tribe DILOBURINI
3. Forehead not elongate and reflexed; crown not produced . . Tribe POIOCERINI

CC. Without a groove between forehead and crown; head produced Subfamily AMYCALINÆ

Subfamily PHENACINÆ

This subfamily may be distinguished by the following characters: Head narrower than the pronotum; crown broad and short, separated from the forehead by a single straight transverse carina; tegminæ elongate, narrow, with the corium twice as long as the clavus, with numerous longitudinal veins and reticulate cross-veins; the legs are usually elongate slender; and the abdomen is frequently provided with long waxy scales.

Key to the American Genera of the Subfamily PHENACINÆ

A. Tegminæ transparent, cross-veins regular....... *Pterodictya* Burmeister
AA. Tegminæ opaque, cross-veins irregular.
  B. Forehead narrow above, broadly ampliate ventrad; intermediate carinæ broadly curved and united dorsad..................... *Phenax* Germar 1833a: 175
  BB. Forehead broader than long, not narrowed above; intermediate carinæ strongly diverging.
    C. Pronotum as long as mesonotum, with a distinct median carina *Menenia* Stål 1866a: 139
    CC. Pronotum shorter than mesonotum with two elongate impressions converging caudad; with an obtuse tubercle cephalad between the impressions...... *Cerogenes* Horvath 1909b: 632

PTERODICTYA Burm.

(Burmeister 1835a: 155)

Haplotype *Fulgora reticularis* Olivier, (*Tettigonia ephemera* Fabricius).

This is one of the most conspicuous and readily recognized genera of FULGORIDÆ. The tegminæ are transparent with numerous longitudinal veins and numerous rather straight cross-veins which are nearly uniformly distributed from base to apex.

PTERODICTYA RETICULARIS Oliv.

Fulgora reticularis Olivier 1791a: 574; *Tettigonia ephemera* Fabricius 1794a: 25; *Pterodictya ephemera* Burmeister 1835a: 155; *Pterodictya nigrolineata* Blanchard and Brulle 1846a: 221.

This species has a wide distribution in Central and South America, ranging as far north as Panama and as far south as Argentina. We have seen numerous specimens from South America and can find no reliable character to distinguish *nigrolineata* from *reticularis*.

There is a single specimen from Barro Colorado, 13 August 1934, Otis E. Shattuck, Museum of Comparative Zoölogy.

Subfamily POIOCERINÆ

In this subfamily the head is broad, the forehead and crown are broad and there is a distinct groove between them bordered by carinæ. I recognize no less than four tribes, only one of which is very extensive.

Tribe PARALYSTRINI

This is a very distinct tribe of the subfamily POIOCERINÆ. In general appearance the species resembles certain tropical species of the family FLATIDÆ, but are true FULGORIDÆ with the anal area of the hind wings reticulate; the clypeus with lateral carinæ; and the second tarsus of the hind leg long with a row of small spines at the apex.

The members of this tribe may be distinguished by the distinct groove between the forehead and crown. The tegminæ are broad with a broad reticulate costal margin which is distinctly sinuate beyond the middle.

The genus *Paralystra* was described many years ago for a single species from Brazil. We have two species from Brazil which undoubtedly represent a new genus of this interesting tribe.

Tribe LYSTRINI

This tribe is represented by the well known genus *Lystra*. It may be readily recognized by the facts that the forehead is quadrate; the lateral margins broadly elevated; crown excavated with the lateral margins produced into triangular teeth above the eyes. The pronotum is provided with a triangular tooth behind the eyes. The tegminæ are strongly tectiform and the legs are elongate slender.

Tribe POIOCERINI

In this tribe the body is somewhat depressed. The head is frequently broad or very broad. The crown is strongly transverse not produced. The forehead is usually transverse. The pronotum and mesonotum are generally flat. The tegminæ are narrow and elongate.

This is the largest tribe of the subfamily POIOCERINÆ. Twenty-eight genera have been described from the Americas and many others are in our collection awaiting description. I recognize two subtribes, POIOCERINA with the last dorsal abdominal (sixth) segment of the female not produced and CALYPTOPROCTINA with the last dorsal segment of the female longer than the penultimate.

A Key to the Known American Genera of the Tribe POIOCERINI

A. Last dorsal segment of the abdomen of the female not produced, about as long as penultimate. Basal margins of clypeus distinctly rounded.

B. Pronotum truncate posteriorly, longer than mesonotum . . . . *Amantia* Stål 1864b: 49

BB. Pronotum broadly sinuate posteriorly, shorter than the mesonotum.

C. Tegminæ abruptly transparent apically *1*

1. Head including the eyes broader than the pronotum . . . . . *Crepusia* Stål
1. Head much narrower than the pronotum *2*
2. Veins on the basal area of tegminæ strong, reticulations inconspicuous; media branched before the middle . . . . *Florichisme* Kirkaldy 1904c: 279
2. Veins on the basal area of tegminæ weak, media branching near the apical area . . . . *Hypæpa* Stål 1862a: 306

CC. Tegminæ opaque or translucent throughout *1*

1. Anterior legs compressed, femora dilated below . . . . *Poiocera* Laporte 1832b: 221
1. Anterior legs simple, slender *2*
2. Tegminæ narrowed apically, with a distinct ruga from the costal margin to apex of clavus . . . . *Aburia* Stål
2. Tegminæ not narrowed apically, without a transverse ruga *3*
3. Clypeus bicarinate at the base *4*
3. Clypeus ecarinate or with a single median carina *5*
4. Body oval; tegminæ strongly convex . . . . *Oomima* Berg 1879b: 180
4. Body elongate; tegminæ narrow . . . . *Alaruasa* Distant 1906m: 199
5. Clavus open; claval stem continued beyond the apex of clavus; forehead with transverse ruga near the clypeal suture *6*
5. Clavus closed; claval stem united to the commissural margin near the apex *7*
6. Head including eyes much narrower than pronotum . . . . . *Zeunasa* Distant 1906m: 200
6. Head including eyes almost as broad as pronotum . . . . *Acræphia* Stål 1866a: 136
7. Clypeal suture deeply impressed; clypeus viewed from the side distinctly curved at the base *8*
7. Clypeus and forehead viewed from the side nearly in the same plane . . . . *Poblicia* Stål 1866a: 138
8. Forehead above the apical lobes more or less ampliate, a transverse ruga above the clypeal suture *9*
8. Forehead broad and parallel above the apical lobes, no transverse ruga above the clypeal suture . . . . *Aliphera* Stål 1866a: 138
9. Head broader than pronotum . . *Itzalana* Distant 1905l: 146
9. Head not broader than pronotum . *Acmonia* Stål 1866a: 137

AA. Last dorsal segment of female abdomen produced at least twice as long as penultimate. Lateral margins of clypeus straight.

B. Tegminæ abruptly transparent apically . . . . *Scaralis* Stål

BB. Tegminæ opaque or translucent not abruptly transparent.

C. Posterior femora longer than anterior, extending beyond the apex of abdomen, with a large spine on the exterior ventral margin; second segment of antennæ cylindric . . . . *Coptopola* Stål 1869b: 239

CC. Posterior femora not longer than anterior, without a spine; second segment of antennæ subglobose *1*

1. Head obtusely angulate anteriorly, crown distinctly longer in the middle than next the eyes . . . . *Tomintus* Stål 1864b: 49
1. Head not angulate *2*
2. Forehead nearly as long as broad with a distinct percurrent median carina and pair of nearly parallel intermediate carinæ . . . . *Jamaicastes* Kirkaldy 1900b: 243
2. Forehead much broader than long without distinct percurrent median carina and intermediate carinæ *3*
3. Postocular area with a tooth like process; anterior femora dilated below . . . . *Cyrpoptus* Stål
3. Postocular area without a tooth like process *4*
4. Pronotum incised behind the eyes *5*
4. Pronotum not incised behind the eyes *6*
5. Forehead with a central fovea; last dorsal segment of female tricarinate . . . . *Calyptoproctus* Spinola
5. Forehead without a central fovea, with a faint median carina; last dorsal segment of female unicarinate . . . . *Pelidnopepla* Stål 1869a: 88
6. A round shining callosity on the basal angles of the fore-head *7*
6. Basal angles of the forehead without a callosity *8*
7. Apex of forehead with a transverse ruga; clypeus ecarinate; mesonotum twice as long as pronotum . . . . *Learcha* Stål 1863b: 240
7. No transverse ruga on forehead; clypeus with a distinct median carina; mesonotum not twice as long as pronotum *Tabocasa* Distant 1906m: 202
8. Basal margin of crown tangent to an imaginary line drawn between the apices of the eyes *Matacosa* Distant 1906m: 198
8. Basal margin of crown distinctly caudad to an imaginary line drawn between the apices of the eyes *9*
9. Head very broad, as broad as pronotum; clypeus ecarinate *Oeagra* Stål 1863b: 239
9. Head somewhat narrower than pronotum, clypeus with a distinct median carina . . . . *Alphina* Stål 1863b: 243

Calyptoproctus Spin.

(Spinola 1839a: 266)

Logotype *Lystra stigma* Fabricius (*Calyptoproctus lystroides* Spinola) Duponchel 1840a: 201.

This genus was established by Spinola for those species of Fulgorids with a produced ("fifth") sixth abdominal segment. He included six species, three of which have subsequently been removed to other genera. Four species have been added to this genus since Spinola's time, making seven species in all, one from "America Septentrionale," two from Mexico and Central America, and four from South America.

The species are generally medium sized, 25mm. or less to apex of tegminæ, generally grayish in color with the veins of the tegminæ and the base of the hind wings frequently reddish. The head is broad, slightly broader than pronotum; the face is transverse, ampliate dorsad with a distinct areolet. The pronotum is short, somewhat truncate anteriorly, distinctly incised behind the eyes and with a well elevated median carina. The tegminæ are narrow, elongate and opaque; with costal margin with numerous cross veins; media and cubitus with numerous branches; clavus closed. Hind tibiæ with four spines. Sixth abdominal segment produced usually nearly as long as the five basal segments combined, tricarinate. Seventh, eighth and ninth segments concealed.

Ball has recently (1933d: 145) made this genus include *Crepusia* Stål but I cannot accept this. Ball's conclusion is that I misinterpreted the description and overlooked the fact that it is the fifth and not the ninth segment that is elongate. Spinola's figure clearly shows that it is the last visible abdominal segment that is elongate. Morphologically and actually the last segment is the sixth, not the ninth or fifth, as anyone can readily see if they will take the time to examine the abdomen of a specimen of any species of *Calyptroproctina* and not simply jump to conclusions. There are at least twelve genera of American POIOCERINÆ that have the last visible dorsal segment longer than the penultimate. My *Crepusia glauca* does not belong in *Crepusia* or *Calyptoproctus* and is not identical with *marmoratus* Spinola but belongs perhaps to the genus *Alphina* Stål (Plate XXII). So far as I know no one has seen a genuine *marmoratus* recently. Spinola gives Amerique Septentrionale for distribution of this species which may include Mexico and Central America. I had a specimen of the female of *glauca;* the sixth segment is about twice as long as the fifth hence, "not produced" with sides deflexed hence, "tricarinate" whereas in *Calypto-*

proctus the sixth segment is about four times as long as the fifth nearly as long as the first five segments combined hence, "produced" with sides not deflexed hence, "quinquecarinate." These characters agree with Spinola's figures and description whereas *glauca* agrees with neither but does agree with Dozier's description of *marmoratus* which is *glauca*. Every key ever devised can easily be misinterpreted for keys can at best be only a brief display of the characters involved.

Calyptoproctus elegans Oliv.

Plates VIII, XXI

Fulgora elegans Olivier 1791a: 574.

This is a large species of *Calyptoproctus*. The general color of the head, the thorax, the legs and the ventral side of the abdomen is ochraceous buff, more or less marbled with fuscous. The tegminæ are rosy red at the base, translucent apically. The hind wings are transparent. The abdomen above is bluish black with the posterior borders of the basal segments pale bluish green. There is a pair of large spots of the same color on the sixth segment.

The crown is about four times as broad as long, nearly parallel margined; the forehead is broad; distinctly ampliate dorsad; central areolet indistinct. Pronotum with a strong median carina which ends in a strong transverse ruga posteriorly; post-ocular incisions deep. Sixth dorsal abdominal segment produced, nearly as long as the basal segments combined; tricarinate, the carinæ parallel.

This species was described from Guiana and has been recorded from Brazil. I have a female from Barro Colorado, 2 August 1924, N. B.; two females, Barro Colorado, 27 June 1933, J. D. and H. Hood in the National Museum; and seven females and two males, Barro Colorado, October to December, M. Bates, in the Museum of Comparative Zoölogy.

Crepusia Stål

(Stål 1866a: 138)

Logotype *Poiocera miniacea* Germar 1830a: 54 (includes *Lystra servillei* Guerin-Meneville 1838a: 187.)

Ball states that "*Crepusia* is apparently one of the many genera proposed by Stål in his Hemiptera Africana keys that were never described or to which no species were referred. It seems best, therefore, to fix *glauca* Metcalf as the type of *Crepusia* Stål." As is well known

to most Hemipterists Stål listed species for most of the genera not included in his Hemiptera Africana in his Analecta Hemipterologica, Berliner Ent. Zeits. **10**; 1866. Two species were listed for *Crepusia* Stål 1866c: 391, *Poiocera servillei* Guerin-Meneville and *P. nuptialis* Gerstæcker. One of the other of these two species must be selected as the type. Since no type has been selected and since I have from Brazil a species which I identify as *miniacea* Germar (includes *servillei* Guerin-Meneville) I have selected it as the type. *Miniacea* is not congeneric with *glauca*. I was misled by Stål's emphasis on the presence of a transverse carina on the pronotum. This is not a valid generic distinction but applies to a whole series of genera.

Crepusia Stål may be briefly characterized as follows: Head broad, as broad as or nearly as broad as pronotum; crown transverse, all margins carinate; forehead transverse, rugulose, ampliate dorsad; clypeal margin bisinuate; clypeus somewhat impressed; pronotum rather elongate, shorter than mesonotum, tricarinate, the intermediate carinæ diverging following the contour of the eyes, a transverse rugæ near posterior border; mesonotum nearly as long as crown and pronotum together, tricarinate, the intermediate carinæ sinuate; tegminæ coriaceous on basal two-thirds, suddenly transparent apically; subcosta and radius unbranched before apex of clavus; media three branched; first cubital sector branched; clavus closed, claval stem uniting with commissural margin before apex; hind tibæ with four or five spines; sixth abdominal segment not produced.

Crepusia ornata spec. nov.

Plate VIII

Head broad, broader than pronotum. Crown short trough-like; anterior, posterior and lateral margins carinate. Forehead transverse, ampliate dorsad, slightly lobate ventrad; deeply impressed above the clypeal suture, with a distinct transverse ridge and with an indistinct median and a pair of more distinct intermediate carinæ which curve outward toward the eyes and are united dorsad by a distinct transverse ruga; whole surface of forehead rugulose. Pronotum about half as long as mesonotum, with a distinct median carina and indistinct transverse ruga. Mesonotum tricarinate. Tegminæ narrow, elongate, with the basal area rugulose; the transparent apical area with numerous straight cross veins. Sixth abdominal segment about as long as fifth, not produced.

Crown, pronotum and mesonotum testaceous yellow, shaded with

fuscous and marked with black as follows: Narrow anterior border of pronotum and four longitudinal vitæ on the mesonotum. Forehead and beneath reddish; the legs the same color with the coxæ, femora and tibiæ ringed with black. The abdomen with small black spots on the basal angles next the pleural pieces. Tegminæ red on the basal opaque area, with large testaceous yellow spots; there are usually five or six spots on corium and three or four on the clavus, in addition to the three large spots at the apex of the opaque area, which are more or less bordered with black, most of the longitudinal veins are narrowly bordered with black; the apical area is transparent, veins brown. The hind wings are transparent with brown veins; the basal area is bright red clouded with fuscous at the base and along the anal and apical margins. The abdomen is red above the first three segments largely black; the fourth, fifth and sixth segments have a small median black spot and a pair of round black spots on the lateral fields.

Length to apex of abdomen 11.3 mm.; wing expanse 30 mm.

Holotype, female, San Carlos, Costa Rica, in the National Museum.

Paratypes, two females, San Carlos, Costa Rica, in the National Museum.

Aburia Stål

(Stål 1866a: 138 and 1866c: 390)

Logotype *Poiocera coleoptrata* Gerstæcker.

Stål places two species *coleoptrata* Gerstæcker and *olivacea* Blanchard in this genus. I have selected the type as indicated above.

This is a very distinct genus of POIOCERINÆ. The body is depressed, the head is narrow and the tegminæ are broad and flat. Forehead nearly as long as broad, lobate ventrad, surface rugulose, median carina fairly distinct ventrad. Pronotum elongate without median carina with two distinct punctiform impressions. Tegminæ broad, flat, distinctly narrowed apically; the basal area with a few strongly elevated straight veins, with indistinct reticulations between; apical membrane depressed, with numerous longitudinal and cross veins. Posterior tibiæ with four spines.

Aburia coleoptrata Gerst.

Gerstæcker 1860a: 229.

The general color of this species is bright cinnamon, more or less marked with black especially below. Crown with two shallow im-

pressed black points. Pronotum with two deeper impressed points. Mesonotum with an indefinite median longitudinal fascia and the lateral fields blackish fuscous, and two shallow impressed points near the posterior border. The tegminæ are irregularly marked with black in the reticulations between the veins, there is an irregular transverse black fascia between the base and the membrane, this fascia is extended as a pair of irregular longitudinal vittæ to the apex. Forehead and clypeus fuscous; legs and beneath chiefly black; pleural pieces bright yellow spotted with black; anterior and middle tibiæ ringed with bright yellow beyond the middle; abdomen black with the segments narrowly margined with bright orange yellow.

Length to apex of tegmina 17.2 mm.

There is a single female in the National collection from San Carlos, Costa Rica.

Cyrpoptus Stål

(Stål 1862a: 304)

Haplotype *Cyrpoptus suavis* Stål.

This is a fairly distinct genus of POIOCERINÆ. The head is broad. The crown is transverse, somewhat longer on the median line than next to the eyes. The postocular area is distinctly produced, toothlike. The pronotum is incised behind the eyes. The tegminæ are elongate, somewhat flaring apically. The anterior femora are somewhat dilated below. The last abdominal segment of the female produced.

The known species of this genus range from the southern United States to Cuba and Mexico.

Cyrpoptus obscurus spec. nov.

Plates IX, XXII

This is a rather large species of *Cyrpoptus* with completely transparent hind wings and completely opaque tegminæ.

The general color of the head, thorax and tegminæ, ochraceous buff; more or less suffused with red, especially on the veins of the tegminæ; the tegminæ also marked with obscure fuscous, forming a fairly distinct vitta between the veins of the clavus. Hind wings transparent throughout; veins fuscous. Entire underside, including legs, fuscous with numerous small ochraceous dots.

Forehead rather long and narrow. Crown long. Pronotum with a rather distinct median percurrent carina and a pair of conspicuous

straight intermediate carinæ behind the eyes. Mesonotum with an obscure median carina. Media and cubitus forked at about the same level, slightly before the middle of the wing, considerably before the level of the union of the claval veins.

Length to apex of abdomen 11.2 mm., wing expanse 31mm.

Holotype, male, Barro Colorado, 3 December 1930, F. E. Lutz, American Museum of Natural History.

Scaralis Stål

(Stål 1863b: 241)

Logotype *Lystra picta* Germ., Distant 1906m: 197.

As I understand this genus from the examination of the type it has a narrow head with the dorsal margin of the forehead broadly curved touching the anterior carina of the crown at the median line; the forehead is ampliate ventrad nearly parallel sided dorsad; there is a faint indication of a median carina and two v-shaped rugæ which touch the median carina below the middle. The clypeus is deeply impressed at the base. The margins of the crown are nearly parallel; there is a small postocular tooth. The pronotum is broad and short; truncate anteriorly; broadly sinuate posteriorly with median carina and distinct transverse ruga near the posterior border. The mesonotum is as long as the pronotum, tricarinate; intermediate carinæ connected by a transverse ruga on the anterior margin. The tegminæ are broad; abruptly transparent apically. Cross-veins irregularly reticulate on the opaque basal area, simple on the transparent apical area. Clavus closed, the claval stem united with the commissural margin. The legs are slender and simple; hind tibiæ with four or five spines. The last dorsal abdominal segment is elongate, produced; two or three times as long as penultimate.

There seems to be considerable confusion about the species of this genus. Distant (1887c and d: 32–33) placed *neotropicalis* and *obscura* in the genus *Jamaicastes* Kirkaldy (*Domitia* Stål) and *spectabilis* in *Scaralis* Stål. *Neotropicalis* and *obscura* have little in common with *Jamaicastes* and are very closely related to *picta*, hence I place them in the genus *Scaralis*. *Spectabilis*, judging from the figure alone, belongs to the genus *Poblicia*.

Scaralis neotropicalis Dist.

Plates IX, XXI

Domitia neotropicalis Distant 1887c: 32; pl. 5, figs. 3, 3a.

There is a single female of this species in the Museum of Comparative Zoölogy from Barro Colorado, October 26, M. Bates.

It is a beautiful species with the head and thorax largely dark green and testaceous, marked with cinnamon. The tegminæ are light ochraceous buff and the veins and cross-veins of the opaque area dark green. The basal area of the hind wings black, with a few irregular spots and cross-veins bright blue. The abdomen and femora are red, with the dorsal segments narrowly bordered with green; the last segment of the female is about twice as long as the penultimate.

Length to apex of abdomen 21.5mm.; wing expanse 66mm.

Tribe DILOBURINI

In this tribe the head is somewhat produced in front of eyes; the forehead is elongate frequently broadly ampliate ventrad; the tegminæ are elongate, costal margin usually large, clavus sometimes open, sometimes closed.

Key to the Genera of Diloburini

A. Clavus open, claval stem extending beyond the apex of the clavus or claval stem uniting with apex of clavus.
- B. Crown twice as long as broad........*Episcius* Spinola 1839a: 249
- BB. Crown much broader than long.
  - C. Forehead with median carina faint or wanting, intermediate carinæ united above. Six prominent spines on posterior tibiæ *Echetra* Walker 1858a: 36
  - CC. Forehead with four carinæ united above by a large callous area *Aracynthus* Stål 1866a: 136

AA. Clavus closed, claval stem united with the commissural margin before the apex.
- B. Forehead without percurrent carinæ.
  - C. Sixth abdominal segment of the female produced.......... *Japetus* Stål 1863b: 244
  - CC. Sixth abdominal segment of the female not produced....... *Dilobura* Spinola 1839a: 254
- BB. Forehead with a median percurrent carina.
  - C. Forehead with three percurrent carinæ, with five stout spines on posterior tibiæ..................*Obia* Distant 1887c: 29
  - CC. Forehead with a single percurrent carina; posterior tibiæ with numerous fine spines.......*Abrahameria* Distant 1920a: 126

Subfamily APHANINÆ

This subfamily may be recognized by these characters: The forehead is broadly ampliate ventrad, narrowed dorsad; the intermediate carinæ of the forehead are continued as the lateral carinæ of the cephalic process, if present; if the process is reduced the carinæ are continued over the margin between the forehead and crown and converge on the crown.

This subfamily may be divided into two tribes, the APHANINI and the ENCHOPHORINI.

Tribe APHANINI

This tribe has the pronotum flat with a faint median carina or none. This tribe is composed of 24 known genera and is almost completely confined to the Eastern Hemisphere but will include the South American genus, *Copidocephala* Stål.

COPIDOCEPHALA Stål

(Stål 1869b: 235)

(*Coanaco* Distant 1887c: 29)

Orthotype *Enchophora guttata* White.

This genus may be recognized by the slender erect cephalic process which is not recurved as in *Enchophora* and the pronotum is not tectiform as in *Enchophora*. The forehead is very broad on the clypeal margin rather suddenly constricted dorsad and then gradually narrowed to middle of the eyes and then suddenly to the cephalic process; there are two percurrent intermediate carinæ which branch near the clypeal margin, one branch extending towards the median line and the other towards the lateral margins. The pronotum is large; with a median and a pair of diverging intermediate carinæ, which extend to the posterior margin and have parallel carinæ ventrad on the lateral margins. The mesonotum is relatively small with a faint median carina. The tegminæ are largely reticulate over the entire surface of the clavus and corium. The legs are rather short; the hind tibiæ are elongate with five or six stout spines.

This is a small genus with five species from Central and South America.

Copidocephala ornanda Dist.

Plates VII, XXI

Distant 1887c: 29; pl. IV, figs. 13a-b.

This species may be recognized by the dull fuscous color of the head thorax and tegminæ, the latter spotted with black basally and with pale luteous apically, some of the black spots have red centers. The hind wings are fuscous with numerous bluish green spots. The abdomen is bright red above with the first three segments black and the median area of the other segments and the anal segments black. Beneath except the face and the lateral pieces of the pronotum, dull red.

Length to apex of tegminæ 27 mm.

There is a single specimen in the National Museum from Barro Colorado, 7 March 1929, S. W. Frost.

Tribe ENCHOPHORINI

This tribe has the median carina strongly elevated and the pronotum steeply tectiform. All the 6 known genera are confined to tropical America.

Key to the Known Genera of the Tribe Enchophorini

A. Cephalic process appressed, short, strongly recurved; apex resting on the crown . . . . *Artacie* Stål 1866a: 131

AA. Cephalic process not appressed, apex free.

- B. Tegminæ opaque . . . . *Enchophora* Spinola
- BB. Tegminæ transparent in part at least.
  - C. Forehead strongly lobate ventrad; tegminæ transparent before the middle . . . . *Chilobia* Stål 1863b: 237
  - CC. Lateral margins of the forehead not lobate ventrad *1*
    - 1. Tegminæ almost completely transparent; cephalic process slender, acuminate, porrect at base and somewhat recurved *Enhydria* Walker 1858b: 44
    - 1. Tegminæ on basal half opaque; cephalic process about as long as pronotum, robust . . . . *Ecuadoria* Distant 1906l:21

Enchophora Spin.

(Spinola 1839a: 221)

Logotype *Fulgora recurva* Oliv., Duponchel 1840a: 200.

This genus may be readily distinguished by the short, slender, recurved cephalic process. The forehead is elongate, ampliate ventrad;

with a distinct median and a pair of intermediate carinæ, which are continued on the cephalic process. The pronotum is strongly tectiform. The mesonotum is tricarinate with the intermediate carinæ strongly curving outward, with a strong curving transverse carina before the apex and with the apex tripartite. Tegminæ coriaceous, strongly reticulate on the basal two-thirds; the membrane with numerous longitudinal veins and simple cross-veins. Hind tibiæ with four or five spines.

About twenty-three species are known from Central and South America.

Key to the Genus ENCHOPHORA

A. Hind wings red at base.
  B. Tegminæ with waxy points on apical area.
    C. Hind wings with conspicuous white dots in the basal red area *stillifera* (Stål) Distant 1887c: 27; pl. 4 (Mexico)
    CC. Hind wings without white dots in basal area *1*
      1. Apical area of tegminæ with waxy points white *2*
      1. Apical area of fore wings with waxy points either yellow or black *3*
      2. Pronotum with a submarginal black fascia. Abdomen above piceous with posterior margins of the segments dull sanguineous . . . . *nigromaculata* Distant 1906l: 23 (Bolivia)
      2. Pronotum without transverse fascia. Abdomen above sanguineous . . . . *sanguinea* Distant
      3. Abdomen tawny. Tegminæ with small orange spots, tips greenish . . . . *pyrrhocrypta* Walker 1851a: 272 (Brazil)
      3. Abdomen above black, hind borders of segments red. Tegminæ with small black dots, tips yellowish brown . . . . *parvipennis* Walker 1858a: 30 (Brazil)
  BB. Tegminæ without waxy points.
    C. Abdomen red above *1*
      1. Tegminæ with transverse fascia *2*
      1. Tegminæ without transverse fascia *5*
      2. With a single apical fascia *3*
      2. With two transverse fasciæ, one at the middle and one before the middle . . . . . . *bohemani* Stål 1854b: 244 (Brazil)
      3. Proboscis of ordinary length reaching hind coxæ *4*
      3. Proboscis long reaching to apex of abdomen . . . . *longirostris* Distant 1887c: 28 (Colombia)
      4. Costal margin with two conspicuous white spots . . . . *ensifera* Germar 1830a: 47 (Brazil)
      4. Costal margin without conspicuous white spots . . . . *florens* Distant 1887c: 28; pl. 4 (Nicaragua, Costa Rica)

5. Legs ringed with black . . . . *fuscata* Spinola 1839a: 229
5. Legs uniform not ringed with black *6*
6. Abdomen red above and gray below . . . .
tuba Germar 1830a: 46 (Brazil)
6. Abdomen red above and below . . . .
recurva (Olivier) Spinola 1839a: 222 (Dutch Guiana)

CC. Abdomen not red above *1*
1. Apical area of hind wings with conspicuous white dots . . . .
dufouri Signoret 1858c: 497 (French Guiana)
1. Apical area of hind wings without white dots *2*
2. Anterior tibiæ twice ringed with black . . . .
brachialis Stål 1862e: 1 (Brazil)
2. Anterior tibiæ not ringed . . . .
eminata Schmidt 1909b: 187 (Brazil)

AA. Hind wings not red at base.

B. Tegminæ with waxy points.

C. Waxy points white *1*
1. Tegminæ red with the veins broadly green. Hind wings chiefly milky white . . . . *rosacea* Distant
1. Hind wings not milky white *2*
2. Tegminæ dark green, hind wings bordered with fuscous . . .
subviridis Distant 1887c: 28; pl. 4 (Panama)
2. Tegminæ and hind wings yellowish testaceous. Hind wings uniform not bordered *distanti* Metcalf [Distant 1887c: pl. 4]

CC. Waxy points black . . . .
viridipennis Spinola 1839a: 225; pl. 11 (Brazil)

BB. Tegminæ without waxy points.

C. Hind wings testaceous or brown . . . .
tuberculata Olivier 1791a: 569 (Dutch Guiana, Brazil)

CC. Hind wings milky white; tegminæ greenish unspotted . . . .
prasina Gerstæcker

Enchophora sanguinea Dist.

Plates VIII, XXI

Distant 1887c: 27.

The female specimens from Barro Colorado are typical dark *sanguinea*. One female from Drayton Trail, Barro Colorado, 11 November 1930, H. F. Schwarz, and another female, 9 October, M. Bates, have the red on the basal area of the tegminæ reduced to circulate spots each spot being bordered with pale yellow brown which makes the spots very conspicuous on the blackish fuscous background. Otherwise they agree with typical *sanguinea*.

The males have the tegminæ pale in color chiefly greenish with a faint indication of rosaceous brown in the cells and the waxy white points are more uniformly distributed over the surface of the corium.

Enchophora longirostris Dist.

Plates VIII, XXI

Distant 1887c: 28.

This is a dull cinnamon buff species with a bright red abdomen. The proboscis is elongate, reaching almost to the apex of the abdomen. The cephalic process is slender and but little expanded apically.

We have a single male from Barro Colorado Island, 24 December 1928, C. H. C.

Enchophora rosacea Dist.

Plates VIII, XX

Distant 1887c: 27; pl. 4, figs. 11a-b.

A single male, 24 December 1929, C. H. C. in the American Museum of Natural History, is typical but decidedly greenish on head, thorax, legs and tegminæ. The median pronotal carina does not extend more than three-fourths the length of the pronotum.

A single female, 27 June 1933, J. D. and H. Hood in the National Museum collection, and a single female 11–13 October, M. Bates in the Museum of Comparative Zoölogy.

Enchophora prasina Gerst.

Plates IX, XXI

Gerstæcker 1895a: 37.

This species was described from Colombia. There is a single pair from Barro Colorado, 4–5 December, collected by M. Bates in the Museum of Comparative Zoölogy.

The general color, light greenish yellow. The head and cephalic process are chiefly dark red. The legs and venter chiefly testaceous, more or less shaded with green on the thorax and with red on the apical segments of the abdomen. Tegminæ light greenish yellow with the costal membrane white and the subcostal vein bordered with dark red dashes from base to apex. Hind wings milky translucent. Abdomen above testaceous, apical segments red, more or less covered with waxy powder.

Subfamily FULGORINÆ

This subfamily includes the larger and more conspicuous genera of Fulgorids. All the known genera have conspicuous cephalic processes and a vertical carina in front of the eyes which is reduced in some genera to a conspicuous triangular tooth.

This family is confined to the tropical regions of the world.

As indicated above I recognize three tribes: FULGORINI (American genera), LATERNARIINI (Oriental genera), and ZANNINI (Oriental and African genera).

Types of Laternaria Linné and Fulgora Linné

Linné (1764a: 152) indicated the new genus *Laternaria* with two species, *phosphorea* and *candelaria*. *Phosphorea* (1764) is the same as *Cicada laternaria* Linné (1758a: 434) which was selected as the type of *Fulgora* by Lamarck (1801a: 291) and therefore cannot be the type of *Laternaria*. I am aware that some people do not accept Lamarck's designations as types but he states, "Pour faire connaître d'une manière certaine les genres dont je donne ici les caractères, j'ai cité sous chacun d'eux une espèce connue, ou très-rarement plusieurs, et j'y ai joint quelques synonymes que je puis certifier; cela suffit pour me faire entendre." This is an excellent statement of the purpose of type designation and it seems to me that it must be accepted as such. The rest of the history known to me is indicated in the table of type designation given below.

The only remaining species of *Laternaria* is *Cicada candelaria* which must be its type. *Pyrops* Spinola (1839a: 231), logotype *Pyrops candelaria* Duponchel (1840a: 200); *Hotinus* Amyot and Serville (1843a: 490), logotype *Laternaria candelaria* Linné; and *Fulgora* [nec Linné] Stål (1866a: 133) are synonymous with *Laternaria*.

Fulgora Linné 1767a: 703

Logotype *Fulgora laternaria* Linné, Lamarck 1801a: 291; 1801a: 258; Duponchel 1840a: 200; Kirkaldy 1900c: 263; 1902d: 47.

Pseudotype *Fulgora europaea* Linné, Laterille 1810b: 434; Kirkaldy 1913a: 11, 14; Muir 1923f: 230.

Pseudotype *Fulgora candelaria* Linné, Distant 1906i: 182; Schmidt 1911c: 161.

(Includes *Laternaria* [nec Linné] Stål 1866a: 132; pseudotype *Laternaria laternaria* Linné, Kirkaldy 1902d: 46.)

LATERNARIA Linné 1764a: 152

Logotype *Laternaria candelaria.*
(Includes *Pyrops* Spinola 1839a: 231; logotype *Fulgora candelaria* Duponchel 1840a: 200, Kirkaldy 1903c: 214.)
(Includes *Hotinus* Amyot and Servielle 1843a: 490; logotype *Fulgora candelaria* Kirkaldy 1903d: 232.)

ZANNA Kirkaldy 1902d: 47

Orthotype *Fulgora tenebrosa* Fabricius, Kirkaldy 1902d: 47.
(Includes *Pyrops* [nec Spinola] Amyot and Servielle 1843a: 491; logotype *Fulgora tenebrosa* Fabricius, Distant 1906i: 179, Schmidt 1911c: 163.)

I recognize that these conclusions are somewhat disturbing but I believe that they are sound and will therefore cause less confusion in the long run. If these conclusions are sound, the American genus now known as *Laternaria* will be known in the future as *Fulgora*, the Oriental genus now known as *Fulgora* will be known as *Laternaria*, and the African and Oriental genus, if all these species remain in one genus in the future, formerly known as *Pyrops* must be called *Zanna*.

Tribe FULGORINI

This tribe includes our largest North American genera. The cephalic process is much modified, frequently with lateral teeth or strongly inflated.

Key to the American Genera of the Tribe FULGORINI

A. Pronotum steeply tectiform, deeply bi-impressed either side of median carina anteriorly . . . . Subtribe FULGORINA
- B. Head large; cephalic process gibbous . . . . *Fulgora* Linné 1767a: 703
- BB. Cephalic process various, not gibbous.
  - C. Cephalic process porrect, with two triangular spines in front of eyes. Crown without a prominent tooth above the eyes . . *Diareusa* Walker
  - CC. Cephalic process toothed on the lateral margins; crown with a prominent tooth above the eyes *1*
    - 1. Apex of cephalic process trilobed, cephalic process with three pairs of triangular teeth laterad . . . *Phrictus* Spinola
    - 1. Apex of cephalic process acute not trilobed, cephalic process with eight pairs of triangular teeth laterad . . . . . . *Cathedra* Kirkaldy 1903b: 179

AA. Pronotum not tectiform, median carina slightly elevated or wanting, impressed points wanting or punctiform not deeply impressed . . . . Subtribe ODONTOPTERINA

B. Clypeus small, about half as wide as the ventral margin of forehead; cephalic process elongate conical with a prominent tooth either side in front of eyes . . . . *Odontoptera* Carreno

BB. Clypeus of normal size; cephalic process of various forms not elongate conical . . . . *Aphrodisias* Kirkaldy 1906b: 248

Diareusa Walk.

(Walker 1858b: 43)

Haplotype *Fulgora annularis* Olivier.

This is a very distinct genus of American Fulgorids. The cephalic process is short with two carinæ dorsad. The forehead is broadly ampliate ventrad with a pair of nearly parallel intermediate carinæ which fork ventrad. The vertical carina anterior to the eye forms a distinct tooth. The tegminæ are elongate with numerous longitudinal veins and reticulate cross-veins; the clavus is open. Hind tibiæ elongate with five or six stout spines.

Diareusa conspersa Schm.

Plates IX, XXI

Schmidt 1906e: 375.

This species was described from Ecuador. A single pair was collected at Barro Colorado, 5 December and 28 January, 1935, M. Bates. They agree in all essential details with Schmidt's description except the color of the spots on the hind wing which are pale yellow instead of orange red.

This species may be distinguished from *D. annularis* Olivier by the following characters: The cephalic process is shorter, nearly parallel sided, not expanded apically as in *annularis;* the dorsal carinæ are straight nearly parallel to near the apex where they gradually converge forming a short median carina. In *annularis* the dorsal carinæ gradually diverge from near the base, and then suddenly converge to form the median carinæ. In *conspersa* there is no distinct median carinæ on the forehead whereas in *annularis* there is a distinct median carina from the apex for more than half the length of the cephalic process. In color the two species are quite similar. The pronotum is spotted with black in *annularis,* unspotted in *conspersa.* The tegminæ are suffused with red at the base in *conspersa* and not in *annularis.*

We have no males for comparison but the female genitalia are very distinct. In *conspersa* the last ventral segment is more than twice as

broad as long, the posterior border broadly sinuate and the lateral margins rounded. In *annularis* the last ventral segment is about one and a half times as broad as long and deeply sinuate, the lateral margins are nearly straight and converge caudad.

Distant (1887c: 25) records *Diareusa annularis* Olivier from Mexico, Guatemala, Panama, Colombia, and Guiana. We have not seen this species from Central America but have specimens of the closely related *D. conspersa* Schmidt from Central America.

PHRICTUS Spin.

(Spinola 1839a: 216)

Haplotype *Fulgora diadema* Linné.

This is one of the most conspicuous genera of the larger FULGORIDÆ. The head has an elongate cephalic process which is expanded apically and trilobed. The cephalic process has three pairs of teeth laterad and there are large supraocular and postocular spines. The pronotum is strongly tectiform. The tegminæ are coriaceous with a few longitudinal veins connected by reticulations on the basal area and numerous nearly straight longitudinal veins on the membrane connected by numerous, usually simple, cross veins. Hind tibiæ with six spines.

Key to the Species of PHRICTUS *Spinola*

(Modified from Schmidt)

A. Cephalic process longer than pronotum.
  B. Cephalic process with three apical teeth.
    C. Tegminæ translucent. Apical area of hind wing with large hyaline spots........*ocellatus* Signoret 1855e: v (Venezuela)
    CC. Tegminæ opaque; apical area of hind wings without hyaline spots...*1*
      1. Apical lobes robust; with anterior margin of lateral lobes crenulate; genital styles obliquely truncate apically...... *tripartitus* Metcalf (British Honduras)
      1. Apical lobes slender; with lateral margins of lateral lobes not crenulate; genital styles broadly rounded apically.... *diadema* Linné (Spinola 1839a: 219) (Brazil)
  BB. Cephalic process with five apical teeth .... *quinquepartitus* Distant (Panama, Colombia)
AA. Cephalic process shorter than pronotum.
  B. Abdomen above and beneath chiefly black.

C. Basal area of hind wings yellow........................
auromaculatus Distant 1905i: 672 (Bolivia)

CC. Basal area of hind wings red or orange red...............*1*

1. Apical area of cephalic process flat; apical spines long and slender............*hoffmannsi* Schmidt 1905b: 338 (Peru)

1. Apical area of cephalic process inflated; apical spines short robust.........*moebiusi* Schmidt 1905b: 340 (Colombia)

BB. Abdomen above black, beneath brownish yellow; basal area of hind wings yellow.........*xanthopterus* Schmidt 1910b: 144 (Ecuador)

Phrictus diadema Linné

Plate XXI

Linné 1767a: 703.

This is one of the smaller species of the genus with the cephalic process longer than the pronotum. The colors are dull or the specimens we have are much faded. A transverse fascia at the base of the membrane is indistinct; the base of the hind wings broadly red, without spots. The genitalia are distinct.

This species is known from Brazil, Dutch Guiana. Distant records a variety from British Honduras which we believe is the species we describe as *tripartitus*.

Phrictus quinquepartitus Dist.

Plates XX, XXI

Distant 1883a: 24.

This is one of the largest species with the cephalic process longer than the pronotum and with five teeth at the apex, with the longitudinal veins and some of the reticulations testaceous yellow and some irregular margins along the costal border black; the transverse fascia at the base of the membrane is testaceous yellow, irregularly bordered with black; the membrane is spotted with the same color with some of the cross veins similarly marked. The base of the hind wing is scarlet red, irregularly spotted with fuscous; the apical and anal margins broadly fuscous with some of the cross-veins pale.

There is a single male specimen from Barro Colorado, 15 July 1933, J. P. Hood; and two males and one female collected in October, December and February by M. Bates.

PHRICTUS TRIPARTITUS spec. nov.

Plates XX, XXI

This species is similar to *diadema*, but the cephalic process is somewhat different and the genitalia are different. The colors appear to be brighter and the transverse fasciæ on the tegminæ more conspicuous.

The cephalic process is longer than the pronotum with the tripartite vertex crenulate on the anterior border, somewhat intermediate between *diadema* and *quinquepartitus*, the median tooth is obtuse, not acute as in *diadema*. The genital styles are broadly divergent as in *diadema* but are obliquely truncate apically and not rounded.

General color of head and thorax cinnamon buff shading to orange-red at the apex of the cephalic process. The head and thorax are more or less marked with black, especially on the lateral areas of the cephalic process, pronotum and mesonotum; the ocular spines are largely black; the ventral area of the cephalic process and forehead are dull testaceous. The tegminæ are largely carmine with the veins and reticulations more or less marked with ochraceous and the transverse fasciæ broad and bright ochraceous yellow; a few irregular black spots along the costal margin and beyond the apex of the clavus. Hind wings bright carmine at the base, fuscous at the apex. Legs and beneath black more or less marked with ochraceous.

Length to apex of tegminæ 39.5 mm.

Holotype, male, British Honduras, American Museum of Natural History.

ODONTOPTERA Carreno

(Carreno 1841a: 275)

Haplotype *Odontoptera spectabilis* Carreno.

This genus was described for *O. spectabilis* from America (?). I have three specimens of this species from Brazil which may be taken as the original habitat. In the present collections there are four specimens of *O. carrenoi* Signoret (1849b: 178) which was also described without locality.

The genus may be characterized as follows: Cephalic process elongate, conical, apex more or less upturned, with a pair of triangular teeth on each side in front of eyes. Clypeus small. Antennæ small; second segment capitate. Tegminæ broad; apical angle produced; the membrane with numerous veins and cross veins.

ODONTOPTERA CARRENOI Sign.

Plates VII, XXI

Signoret 1849b: 178.

Smaller than *O. spectabilis* Carreno with a more elongate cephalic process, shorter anal angle and entirely different coloration.

Head about as long as abdomen, nearly as wide as pronotum, cephalic process elongate, conical; sharply upturned at apex, lateral carinæ faintly indicated on base only, lateral frontal carinæ converging to base of upturned apex, then diverging and continued to apex of process; median dorsal and ventral carinæ very distinct on upturned portion of process. Pronotum smooth, anterior and posterior margins strongly curved. Mesonotum as long as broad, with five faint carinæ. Tegminæ about twice as long as broad; apical angle sharply rounded, broadly produced; costal membrane broad, subcostal vein with numerous branches, media with nine or more branches before the membrane; membrane with numerous veins and cross veins; claval area reticulate. Hind wings reticulate over most of the area. Hind tibiæ with four or five stout spines. Abdomen compressed with a definite median carina dorsad. Female eighth abdominal segment with elongate cerci-like appendages; tenth segment broadly U-shaped with the anal spine between the arms.

General color dark leaf green fading to light yellow green or ochraceous. Lateral margins of the cephalic process fuscous, bordered above and below by creamy white carinæ, upturned apex black; thorax beneath, legs and abdomen dark leaf green fading to ochraceous buff. Tegminæ basally dark leaf green fading to light yellow green, apical margin broadly fuscous; a small black ocellate dot just inside the anal angle. Hind wings with the anal area ochraceous orange with two large black spots; apical area transparent; basal area green.

Redescribed from a pair in the National Museum from Guatemala and a pair from Barro Colorado, collected by M. Bates. Signoret does not describe the black spot on the tegmina but he illustrates it and the species seems to agree in other details.

Subfamily AMYCALINÆ

In this subfamily the head is produced but there is no carina in front of eyes and no groove between forehead and crown.

So far as is known at present this subfamily is strictly American in distribution. It is more closely related to the POIOCERINÆ than to FULGORINÆ.

Key to the Genera of the Subfamily AMYCALINÆ

A. Cephalic process subterete. . . . . . . *Rhabdocephala* Van Duzee 1929a: 190

AA. Cephalic process with lateral carinæ dorsad, flattened between.

B. Cephalic process broad, triangular but little expanded apically; lateral carinæ not crenulate. . . . . *Amycale* Stål 1870b: 291

BB. Cephalic process slender, expanded apically, lateral carinæ crenulate. *Scolopsella* Ball 1905a: 118

Family ACHILIDÆ

This family consists of 64 known genera. The tegminæ have no costal area, claval veins distinct, the claval stem entering apex of clavus, and the apical area of tegminæ is usually enlarged beyond the apex of the clavus.

Key to the Genera of the Family ACHILIDÆ

A. Head broad including eyes, usually more than half as broad as pronotum; the lateral margins of the pronotum continuing the main axes of the eyes.

B. Tegminæ emarginate on the apical margin, not overlapping apically *Apateson* Fowler

BB. Tegminæ not emarginate apically.

C. Crown with the lateral margins distinctly longer than the median line; anterior margin straight or slightly concave. . . . *Ateson* Metcalf

CC. Crown with the median line as long as the lateral margins; anterior margin broadly rounded or angulate. *1*

1. Crown and face both concave, trough-like. . . . . *Kardopocephalus* Metcalf

1. Crown and face not trough-like. *2*

2. Crown separated from the forehead by a distinct transverse carina, or carinæ. *3*

2. Crown not separated from the forehead by a distinct carina. *11*

3. Pronotum very short, usually distinctly shorter than the crown. *4*

3. Pronotum more elongate. *7*

4. Apex of head with two transverse carinæ forming a pair of areolets; a chain of areolets on posterior margin of pronotum. . . . . *Catonia* Uhler

4. Apex of head with a single transverse carina; no chain of areolets on posterior margin of pronotum. *5*

5. Posterior tibiæ with a single spine. Tegminæ nearly horizontal. *6*

5. Posterior tibiæ without apparent spines. Tegminæ steeply tectiform.......................... *Amblycratus* Uhler
6. Forehead elongate flat; clypeus not suddenly and distinctly narrower.................... *Catonoides* Metcalf
6. Forehead broad inflated; clypeus suddenly and distinctly narrower......................... *Plectoderes* Spinola
7. Tegminæ with a distinct costal fold between corium and membrane........................ *Koloptera* Metcalf
7. Costal margin continuous, no costal fold.............. *8*
8. Face narrow, elongate, narrowed between the eyes..... *9*
8. Face broad, not narrowed between the eyes. . *Messeis* Stål
9. With a single carina between forehead and crown...... *10*
9. With two carinæ between forehead and crown, forming areolets........................... *Messoides* Metcalf
10. Posterior tibiæ with four spines; mesonotum short and broad, but little longer than the pronotum............. *Rhotala* (Walk.) Fowler 1905a: 137
10. Posterior tibiæ with a single spine; mesonotum elongate, as long as broad. Pronotum about as long as vertex....... *Rhotella* Metcalf
11. Forehead not separated from crown by an impressed line *12*
11. Forehead separated from crown by an impressed line.... *Cionoderus* Uhler 1895a: 66
12. Subcostal-radial stem, media and first cubital sector all branching at the same level ..... *Phrygia* Stål 1856b: 163
12. Media unbranched before the apical area.............. *Nelidia* Stål 1862e: 66

AA. Head narrow, including eyes usually only about half as wide as pronotum.

B. Crown distinctly produced in front of eyes, median line usually distinctly longer than lateral margins.

C. Crown without a carina on the median line.............. *1*

1. Crown deeply excavated, elongate bifid at the apex reflexed; dorsal margin of face distinctly emarginate....... *Pseudohelicoptera* Fowler 1904b: 107
1. Crown not deeply excavated sulcate on median line, not bifid at the apex; dorsal margin of the face not emarginate *Epiptera* Metcalf 1922a: 264

CC. Crown with a carina on the median line................. *1*

1. Forehead with intermediate carinæ.................... *Taracticus* Berg 1881b: 265
1. Forehead without intermediate carinæ................. *2*
2. Tegminæ with callosities on the membrane beyond the apex of clavus............ *Elidiptera* Spinola 1839a: 304
2. No callosities on the tegminæ.... *Myconus* Stål 1862e: 65

BB. Crown short, transverse, not produced in front of eyes, anterior and posterior margins nearly parallel.
  C. Posterior tibiæ unispinous; base of vertex sinuate *1*
    1. Pronotum twice as broad as the head . . . . . *Achilus* Kirby
    1. Pronotum narrower . . . . *Phypia* Stål

Subfamily APATESONINÆ

This subfamily may be characterized as follows: Crown short, anterior margin straight or concave with a single distinct transverse carina; face concave the lateral margins strongly elevated; tegminæ steeply tectiform, not over-lapping, apex of clavus broadly rounded, claval veins ending in apex; subcostal vein with numerous veinlets to costal margin near apex.

Apateson Fowl.

(Fowler 1900g: 70)

Haplotype *Apateson albomaculatum* Fowl.

This genus was placed in the RICANIIDÆ (i.e. the NOGODINIDÆ) by Fowler, and in the ACHILIDÆ by Muir. It is somewhat anomalous in either family; but the venation is much more like an achilid venation than the venation of the NOGODINIDÆ, hence I place it here for the present and erect a subfamily APATESONINÆ for this genus and *Ateson* Metcalf.

Apateson albomaculatum Fowl.

Plates IX, XV

Fowler 1900g: 70.

This species may be recognized by its blackish color with conspicuous pale yellow or ivory white spots.

Apateson albomaculatum Fowler was described from Mexico, Nicaragua and Panama and I have seen specimens from British Honduras, hence I conclude that it is widely distributed in Central America.

Ateson gen. nov.

Orthotype *Ateson marmoratum* spec. nov.

This genus has the general aspect of *Apateson* Fowler but the tegminæ are not emarginate and the venation is entirely distinct.

Crown short and broad, ecarinate, anterior margin straight. Face

elongate, concave, not narrowed between the eyes, median carina faint, percurrent. Antennæ small, second segment slender, capitate. Pronotum short with distinct median and intermediate carinæ. Mesonotum large, compressed, tricarinate. Tegulæ large. Tegminæ large, steeply tectiform; costal and commissural margins nearly parallel, apical margin broadly rounded. Subcostal vein indistinct basad, with numerous veinlets to the costal margin apically. Radius unbranched before the apical cells. Media with five branches before the apical cells. Claval veins united on the apical fourth; the stem connected with the blunt apex of clavus. Hind tibiæ short, stout with a single stout spine beyond middle.

Ateson marmoratum spec. nov.

Plates II, XV, XXII

This is a blackish brown species with the tegminæ irregularly marked and the veins dotted with ochraceous yellow.

Crown short about three times as broad as long; anterior margin straight, distinctly carinate; posterior margin broadly curved. Forehead and clypeus with lateral margins strongly elevated, carinæ distinct on the basal two-thirds. The last ventral segment of the male broadly triangular, three times as long as broad; central area broadly rounded, somewhat flap-like. Genital styles about twice as long as broad; notched at the apex; the outer and inner angles obtuse.

General color blackish brown shading to testaceous on the forehead, the lateral margins of the head and the center of the thorax. Pronotum, mesonotum, tegminæ and legs blackish brown. The fore tibiæ ringed with ochraceous yellow at the apex. Lateral fields of the pronotum dotted with ochraceous yellow. Cells of the tegminæ irregularly marked and the veins punctuate with ochraceous yellow.

Length to apex of tegminæ 10.4 mm.

Holotype, male, Maroni River, French Guiana.

Allotype, female, Barro Colorado, 26 July 1924, N. Banks.

Paratypes, 1 female, Maroni River, French Guiana; 1 female Barro Colorado, 4 February 1929; 1 male and 1 female, Barro Colorado, July 1923, R. C. Shannon.

Ateson fuscum spec. nov.

Plates II, VIII, IX, XVI, XXII

This species is closely related to *marmoratum* but it is differently colored and has a differently shaped head and distinct genitalia.

General color tawny brown. Crown, pronotum and mesonotum testaceous. Forehead and legs testaceous, the forehead and the lateral fields of the pronotum with numerous small ochraceous yellow pustules. The lateral margins of the forehead with numerous black dashes. The tegminæ almost uniform tawny brown, with the principal veins testaceous and the cross veins ochraceous yellow; the apical cells and the stigmatal area are clouded with blackish fuscous. There is a distinct brownish saddle across the middle of the clavus. Crown shorter than in *marmoratum*, more than four times as long as broad; the carinæ not so strongly elevated. Forehead with the lateral margins nearly parallel, not so strongly elevated; median carina distinct. Mesonotum more elongate than in *marmoratum*. The carinæ more strongly elevated. Tegminæ more strongly rugulose than in *marmoratum*. The last ventral segment about twice as broad as long; the median area separated from the lateral areas by a distinctly rounded notch; the median area triangularly produced; lateral margins sinuate. Genital styles short and broad; distinctly indented apically and the outer angles produced into an acute tooth.

Length to apex of tegminæ 10 mm.

Holotype, male, Barro Colorado, 27 June 1924, N. Banks.

Subfamily ACHILINÆ

This subfamily includes those genera of the Family ACHILIDÆ which have the body depressed; the tegminæ nearly horizontal overlapping more or less beyond apex of clavus; crown produced, separated from forehead by one or two carinæ.

Koloptera gen. nov.

Orthotype *Koloptera callosa* spec. nov.

This genus has a superficial resemblance to *Epiptera* Metcalf. It differs, however, in a number of important respects. The head is broader, is carinate laterally, the pronotum has supernumerary lateral carinæ and the shape and venation of the tegminæ are entirely different.

Head broad produced, the crown about twice as long as broad at base, with a distinct median carina; forehead broad the lateral margins nearly parallel not constricted between eyes, with a distinct median carina; clypeus short about half as long as forehead, carinate; lateral margins of head with a distinct carina from eye to anterior border. Antennæ small, second segment globose. Pronotum with the margins

nearly parallel, three pairs of supernumerary longitudinal carinæ in addition to the median and intermediate carinæ, lateral margins with two carinæ. Mesonotum broader than long. Tegminæ elongate with a characteristic fold on the costal margin in the region of the nodal cell. All the longitudinal veins of the tegminæ converge towards the middle of the line separating corium from membrane and then radiate to the apical margin; there are numerous pseudoveinlets between the costal margin and subcosta; two callosities on either side of the costal fold; radius two-branched; media with three branches; cubitus two bent sharply toward media.

Koloptera callosa spec. nov.

Plates II, IX, XVI

This species bears a superficial resemblance to *Epiptera* (*Helicoptera*) *longiceps* Fowler. The latter species, however, lacks the distinct costal fold.

General color tawny olive with numerous small ochraceous yellow spots and a few clouds of fuscous. Two transverse fuscous fasciæ on the crown and base of the forehead. The forehead and venter ochraceous buff, with the legs and clypeus tawny olive; spines and claws black. The callosities of the tegminæ black; hind wings fuscous.

Length to apex of tegminæ 4.5 mm.

Holotype, male, Las Sabanas, Panama; 7 July 1924, N. B.

Allotype, female, Las Sabanas, Panama; 7 July 1924, N. B.

Paratypes, 1 male, Fort Davis, Canal Zone; 25 July 1924, N. B.; 1 female, Las Sabanas, Panama; 7 July 1924, N. B.

Messeis Stål

(Stål 1862e: 66)

Haplotype *Messeis fuscovaria* Stål.

If I interpret this genus correctly, it resembles *Catonia* Uhler in general appearances. It differs, however, in being more depressed; in having the pronotum distinctly tricarinate without a chain of areolets along the posterior border; the vertex is not separated from the forehead by a transverse carina in addition to the forks of the median facial carina; the venation is quite similar in both genera and the veins are irregularly granulate; the hind tibiæ have a single large spine on the basal third.

Messeis asper Fowl.

Plates VII, XVI, XXII

Plectoderes asper Fowler 1904c: 110.

We have a single male which agrees in essential details with Fowler's short description and illustration. The head and the pronotum are more elongate than is indicated in Fowler's figure. The pronotum is rather heavily marked with testaceous and the basal cells are variegated with deep ferruginous olive.

Messoides gen. nov.

Orthotype *Messoides uniformis* spec. nov.

Superficially this genus suggests *Epiptera* Metcalf. The head is broader; the crown is distinctly carinate on the median line, not sulcate; and the pro- and mesonotum are distinctly tricarinate.

Head broad, distinctly produced in front of eyes. Crown with distinct median carina and strongly elevated lateral margins. Forehead elongate; distinctly narrowed between the eyes, with a distinct median carina which is continued onto the clypeus. Pronotum elongate, tricarinate on the disk; the intermediate carinæ continuous with the lateral margins of the head and with the intermediate carinæ of the mesonotum; lateral margins with two carinæ. Tegminæ with subcosta and radius branching on the basal third; the subcosta branching at the level of the first cubital sector; media with five distinct branches; first cubital sector branching at the level of the union of the claval veins. Hind tibiæ with three stout spines.

Messoides uniformis spec. nov.

Plate X

General color dark cinnamon brown, almost uniform above and below including tegminæ and wings. The veins paler with indistinct dashes of paler fuscous; and subapical margin with an indistinct fascia of black; the first medial sector distinctly black apically.

Crown longer than broad; triangularly produced anteriorly; cephalic areolets deeply impressed. Pronotum with a row of indistinct pustules on the lateral areas behind the middle.

Length to apex of tegmina 12.3 mm.

Holotype, female, Barro Colorado, 29 June 1933, Hood, Hood and Hook. In the collection of the U. S. National Museum.

Catonia Uhl.

(Uhler 1895a: 61)

Logotype *Catonia nava* Say.

This is a conspicuous North American genus which ranges southward through Mexico, Central America and the West Indies to Northern South America.

The genus may be recognized by its broad head, short nearly quadrangular crown with two distinct transverse carinæ anteriorly forming distinct triangular areolets. Forehead distinctly narrowed between the eyes, with an evident median carina. Short collar-like pronotum with a row of areolets along the posterior margin formed by short carinæ from the diverging intermediate carinæ to the posterior border. The venation of the tegminæ is fairly typical. Subcosta and radius are united on the basal third both with short branches before the margin; media with three short branches before the submarginal vein; first cubital sector branching before the middle. Hind tibiæ with a single spine.

Helicoptera sobrina, *H. sobrina* var. *albidovariegata*, and *H. chiriquensis* Fowler undoubtedly belong to the genus *Catonia*.

Catonia sobrina Fowl.

Plate II

Helicoptera sobrina Fowler 1904b: 106.

From the description I judge that *sobrina* is a complex, perhaps of several species. Since I have only a single specimen of *Catonia* from Barro Colorado I prefer to consider it as belonging to this species until the complex can be straightened out. This specimen is lighter than typical *sobrina* as described by Fowler. The clypeus has a strong median carina, irregularly testaceous, lateral margins blackish; forehead not much narrowed between the eyes, base and apex brownish testaceous with an intermediate narrower band of ivory white, lateral margins with rather regular alternate black and ivory white dots. Mesonotum largely blackish testaceous. Tegminæ almost uniform testaceous with the veins dotted with black especially conspicuous on the costal margin.

A single female, Barro Colorado, 24 July 1924, N. B.

Rhotella gen. nov.

Orthotype *Rhotella punctata* spec. nov.

This genus has a head and thorax suggestive of *Pintalia* Stål (CIXIIDÆ) but the other characters are those of a typical Achilid, resembling *Rhotala* Walker but with the pronotum much shorter, and the mesonotum much longer and the posterior tibiæ with a single spine.

Crown with a distinct median carina, sloping anteriorly and gently rounded into forehead but separated by a distinct transverse carina; forehead rather broad with a distinct median carina. Antennæ small, the second segment somewhat longer than wide. Pronotum elongate, with three carinæ; mesonotum longer than broad, with three carinæ. Tegulæ large. Tegminæ coriaceous; subcosta and radius united on the basal fifth, both unbranched before the apical cells; media with three branches before the apical cells; first cubital sector branching before the apex of clavus; claval veins connected by a strong cross vein. Posterior tibiæ with a single spine.

Rhotella punctata spec. nov.

Plates IX, XV

This is a fairly large species of a pale yellowish testaceous color with the tegminæ spotted and clouded with fuscous.

Crown broader than long, median carina very distinct. Forehead broadest at clypeal margin then somewhat rounded and narrowed below the eyes; lateral margins carinate but not strongly elevated, median carina distinct to labrum, ending in a Y-shaped carina separating forehead from crown. Pronotum strongly compressed, the median field between the intermediate carinæ strongly elevated.

General color yellowish testaceous with variable markings of blackish fuscous. The following are marked with blackish fuscous; the eyes, the sides of the forehead in front of eyes, the lateral fields of the pronotum, the pleural pieces, and the abdomen; the fuscous markings on the tegminæ are very variable, and may be represented by minute round points or broad irregular clouds; there are usually several small points at the base of the tegminæ and in the apical cells.

Length to apex of tegminæ, male 6.6 mm.; female 7.1 mm.

Holotype, male, Rio Grande, British Honduras, December 1930, J. J. White. In author's collection.

Allotype, female, Rio Grande, British Honduras, December 1930, J. J. White. In author's collection.

ELIDIPTERA Spin.

(Spinola 1839a: 304)

Logotype *Elidiptera callosa* Spinola.

The genus *Elidiptera* was established by Spinola (1839a: 304) for five species, and this name was long used as the generic name for the common Palearctic and Nearctic species of ACHILIDÆ. *E. callosa* was subsequently selected as the type of *Elidiptera* and since *callosa* is not congeneric with Nearctic and Palearctic species Metcalf (1922a: 263) proposed that the latter group be assigned to the genus *Epiptera*. *Callosa* is apparently the only species belonging to the restricted genus *Elidiptera*. This species is known from Brazil (Spinola) and Trinidad (Muir).

ELIDIPTERA CALLOSA Spin.

Plates II, X, XVI

Spinola 1839a: 305.

A single female from Red Tank, Canal Zone, 30 June 1924, agrees in essential details with the original description and illustration of this species although it differs considerably in coloration. The chances are that a careful comparison between these Central American forms, the specimens Muir received from Trinidad and specimens from Brazil might show constant specific differences.

The present specimen differs chiefly from typical *callosa* in having a regular series of diagonal fuscous markings in the costal area extending from the base of the tegminæ to the nodal cell, the markings on the tegminæ are more irregular, and there are two callosities on the tegminæ, the posterior small but distinct.

CATONOIDES gen. nov.

Orthotype *Catonoides fusca* spec. nov.

This genus resembles *Catonia* Uhler but is more depressed. There is only a single transverse carina between the forehead and crown. The forehead is not narrowed between the eyes and the pronotum is without areolets on the posterior margin. Mesonotum about as long as broad, tricarinate. Tegminæ with the radial-subcostal fork, the forking of the first cubital sector and the union of the claval veins at the same level; media forked toward the apex. Hind tibiæ with a single spine.

Catonoides fusca spec. nov.

This species has the appearance of a small dull *Catonia*.

The crown is broad, triangularly produced apically. Forehead with a distinct median and lateral carinæ which are continued on the clypeus. Pronotum with indistinct carinæ.

General color cinnamon brown, irregularly marked with ochraceous buff and ochraceous tawny and fuscous. Crown and thorax ochraceous buff. The mesonotum with a broad transverse fascia of ochraceous tawny behind the middle. Face and beneath including legs uniform ochraceous tawny. Tegminæ chiefly ochraceous tawny, with the transverse veins and the apical margins marked with ochraceous buff; and the cells irregularly clouded with fuscous.

Length to apex of tegminæ 4.9 mm.

Holotype, female, Barro Colorado, 12 July 1924, N. B.

Plectoderes Spin.

(Spinola 1839a: 328)

Haplotype *Flata collaris* Fabricius.

This is a genus of small flat compact Achilids. The forehead is broad and short with a distinct median and lateral carinæ. It has a single carina between the forehead and crown; crown flat with a distinct median carina, the lateral margins are elevated. The pronotum is very short. The mesonotum is large, tricarinate. The venation is relatively simple and the forking of the radial-subcostal stem, the first cubital sector and the union of the claval veins are at about the same level. The hind tibiæ have a single spine.

Fowler described nine species in this genus. If his illustrations are correct, I believe that some of these species belong to *Amblycratus* Uhler and others to *Catonoides* Metcalf.

Plectoderes collaris Fabr.

Plates X, XVI

Fabricius 1803a: 53.

We have a single specimen of this species from Maroni River, French Guiana which agrees with Spinola's illustration and the general description of this species. There is also a single female in the National Museum collection from Barro Colorado, 18 April 1929, S. W. Frost,

which agrees in essential details and color. It is smaller and lacks the light costal margins characteristic of this species, but until more specimens are available it should remain here.

Plectoderes scapularis spec. nov.

Plates X, XVI, XXII

This is one of the smaller species of *Plectoderes*; black marked with pale yellow.

The head nearly as wide as pronotum; crown short transverse, about twice as broad as long, distinctly impressed. Forehead rather long for *Plectoderes*, distinctly inflated; median carina indistinct; whole surface finely rugulose. Clypeus rather large for *Plectoderes*, triangular; median and lateral carinæ strongly elevated. Pronotum short; median and intermediate carinæ rather distinct for *Plectoderes*. Mesonotum about as long as broad, strongly elevated, tricarinate; the intermediate carinæ somewhat diverging laterad. Venation somewhat typical; subcosta distant from the costal margin, strongly curved; radius distant from and running nearly parallel to the subcosta; media and first cubital sector closely crowded together.

General color black, strongly marked with bright yellow as follows: Posterior half and lateral margins of crown; posterior border and carinæ of pronotum; the lateral margins of the mesonotum; the claval and commissural margins of the tegminæ, with a broad vitta from near the base extending between the subcosta and radius. Beneath, the clypeus, the lateral fields of the pronotum and the basal half of the tegulæ are yellow.

Length to apex of tegminæ 5.5 mm.

Holotype, male, Rio Grande, British Honduras, February 1932, J. J. White.

On the basis of venation this species should perhaps constitute a new genus but the characters of the head and thorax are similar to *Plectoderes*, hence I place it there until the whole family may be restudied.

Amblycratus Uhl.

(Uhler 1895a: 64)

Haplotype *Amblycratus pallidus* Uhl.

This genus was described for a single species from St. Vincent Island, West Indies. As I understand this genus it is closely related to *Plecto-*

deres but the crown is broad, slightly angulate anteriorly and separated from the forehead by a single carina. The forehead is broad nearly parallel margined, not much wider than the clypeus. Both the forehead and clypeus are provided with a median carina and strongly elevated lateral margins. The pronotum is narrow. The mesonotum is about as long as broad, strongly inflated with three carinæ. The tegminæ are steeply tectiform, long and narrow; subcostal-radial stem branching on the basal third; media with three branches; subapical cells long and narrow. Hind tibiæ without conspicuous spines.

Amblycratus fuscolineatus Fowl.

Plates X, XV, XXII

Plectoderes fuscolineatus Fowler 1904c: 111.

A single male from Gamboa, Canal Zone, 9 July 1924, N. B., agrees with Fowler's short description and illustration.

Amblycratus fuscus spec. nov.

Plate XXII

This species differs from *fuscolineatus* Fowler chiefly in color being nearly uniform honey yellow with the veins not lineate with fuscous. The male genitalia entirely distinct.

Crown more elongate than in *fuscolineatus*. Forehead with lateral margins parallel broader than in *fuscolineatus*. Pronotum nearly crescentric very short behind the eyes, venation indistinct but typical.

General color honey yellow, eyes black, ocelli deep coral red. Tegminæ uniform honey yellow slightly paler apically. Costal margin and some of the veins narrowly marked with bright red.

Length to apex of tegminæ 5.1 mm.

Holotype, male, Barro Colorado, 29 July 1924, N. B.

Allotype, female, Barro Colorado, 26 June 1924, N. B.

Paratypes, 1 female, Barro Colorado, 27 June 1924, N. B.; 1 male, Barro Colorado, 21 June 1924, N. B.

Kardopocephalus gen. nov.

Orthotype *Kardopocephalus lineatus* spec. nov.

This genus may be recognized by the elongate head with a trough-like crown; elongate tegminæ with two callosities at the apical angle.

Head produced; crown with the lateral margins strongly elevated; median carina faint on basal half. Forehead elongate triangular, deeply impressed; lateral margins straight, converging from the clypeal margin to the apex of the head. Pronotum elongate; tricarinate with supernumerary carinæ laterad. Mesonotum broader than long, tricarinate. Tegminæ elongate with the venation simple; subcosta and radius united on the basal third; media unbranched before the membrane; first cubital sector branched at the level of the union of claval veins. Posterior tibiæ without spines.

Kardopocephalus lineatus spec. nov.

Plates XI, XVI, XXII

Crown more than twice as long as basal width, trough like; basal margins broadly sinuate. Forehead with the lateral margins strongly elevated; median carina distinct to apex of clypeus. Pronotum triangularly excavated posteriorly. Mesonotum about five times as long as pronotum.

General color deep olive buff with the mesonotum and the tegminæ strongly lineate with fuscous. Eyes marked with fuscous. Mesonotum with the carinæ pale broadly lineate with fuscous. Tegminæ with the veins clay color, broadly margined with fuscous leaving a narrow longitudinal vitta of olive buff in each cell.

Length to apex of tegminæ 8.8 mm.

Holotype, male, San Antonia, British Honduras, May 1931, J. J. White.

Myconus Stål

(Stål 1862e: 65)

Haplotype *Achilus conspersinervis* Stål.

As I interpret this genus it is depressed with a narrow head which projects in front of the eyes. The crown is transverse with a distinct median carina and separated from the forehead by a distinct transverse carina. The forehead is elongate with a distinct median carina which is continued onto the clypeus. The pronotum is produced to the middle of the eyes; the central area is bounded by straight diverging carinæ. The mesonotum is about as long as broad with three parallel carinæ. The tegminæ are rather broad not strongly overlapping; the subcostal radial stem branches on the basal third; the media branches before the membrane; the first cubital sector just before the apex of clavus.

Myconus conspersinervis Stål

Plates XI, XVI

Achilus conspersinervis Stål 1862e: 3.

I have a single specimen of this species from British Honduras which agrees in essential details with Fowler's description.

The general color of the tegminæ is sordid white, with the head and thorax, legs and abdomen fuscous. The veins of the tegminæ are spotted with minute spots of fuscous and the cells are dotted with minute points of the same color.

Family TROPIDUCHIDÆ

This is a small family of about 80 genera. It was revised by Melichar (1914f) and I follow his classification in the following discussion.

Muir states that there is always a distinct suture which restricts the posterior angle of the mesonotum. In most genera there is a transverse row of cross veins or cross line across the tegminæ. The head is various, sometimes with and sometimes without a cephalic process. The former genera superficially resemble members of the family DICTYOPHARIDÆ but may be readily distinguished by the small second joint of the hind tarsi, with a spine on each side.

Key to the Subfamilies and Tribes of the Family Tropiduchidæ

(Modified from Muir)

A. Costal area with cross veins .... Subfamily TROPIDUCHINÆ
- B. Antennæ short, globose .... Tribe TROPIDUCHINI
- BB. Antennæ more elongate, segments cylindric; second segment visible from above.... Tribe CATULLIINI (No American genera)

AA. Costal area absent or small, without cross veins .... Subfamily TAMBINIINÆ
- B. Subcosta with several furcate branches to costal margin .... Tribe ALCESTISINI
- BB. Subcosta without furcate branches to costal margin.
  - C. Tegminæ leathery .... Tribe HIRACIINI
  - CC. Tegminæ transparent *1*
    - 1. No subapical line on tegminæ .... Tribe TRYPETIMORPHINI (No American genera)
    - 1. Subapical line present *2*
    - 2. Subapical line basad of the middle of tegminæ .... Tribe PARICANINI (A single American genus *Achilorma* Metcalf and Bruner 1930a: 400).
    - 2. Subapical line distad of the middle of tegminæ .... Tribe TAMBINIINI

Tribe TROPIDUCHINI

In this tribe the tegminæ are transparent with a distinct row of cross veins separating basal corium from apical membrane; there is a distinct costal membrane with numerous cross veins.

Melichar recognized three genera in this group. Metcalf and Bruner (1930a: 397) pointed out that Melichar's genus *Tangiopsis* was preoccupied by *Tangiopsis* Uhler and proposed the new name *Tangiella.* They also included Van Duzee's (1907a: 35) *Tangia sponsa* from Jamaica. A reexamination of this material convinces me that this assignment is incorrect. I propose for *Tangia sponsa* Van Duzee from Jamaica, *nec Tangia sponsa* that is *Neurotmeta sponsa* Guerin-Meneville, the new genus *Pseudotangia* and the new species *sponsa.* (Plates X, XV). This genus differs from *Tangiella* Metcalf and Bruner in possessing a distinct cephalic process; in having the forehead more elongate with a fine median carina instead of a broad roll like carinæ; crown elongate with faint median carina.

Key to the American Genera of the Tribe Tropiduchini

A. With a cephalic process crown two or three times as broad as long...... *Pseudotangia* Metcalf

AA. Without a cephalic process.

B. Forehead with a median carina and two diverging carinæ from the clypeal suture............................ *Vanuoides* Metcalf

BB. Forehead with median carina only ....*Ladella* Stål

VANUOIDES gen. nov.

Orthotype *Vanuoides pallescens* spec. nov.

This genus resembles *Vanua* Kirkaldy in general head characters with a more produced crown but the venation is different.

Head narrow only about half as wide as the pronotum; crown produced, the lateral margins converging slightly anteriorly and rounded on the anterior margin, the lateral and anterior margins sharply carinate, median carina on anterior half then branching to the posterior margin and continued on posterior margin to lateral borders; forehead with stout median carina and short intermediate carinæ diverging dorsad; lateral margins strongly carinate. Clypeus short, depressed; with a median carina. Antennæ short and slender. Pronotum short, impressed and tricarinate on the disc, with two lateral carinæ; mesonotum tricarinate. Tegminæ elongate; membrane distinct separated from

corium by a cross line, with numerous cross veins; costal membrane narrow, with several cross veins; radius branched just before transverse vein; media and cubitus branched before the middle, the second medial sector branched before the transverse vein. Legs rather slender; hind tibiæ with three spines on the apical half.

Vanuoides pallescens spec. nov.

Plates X, XVI

General color warm buff, with the carinæ of the head, the thorax and the veins bright red.

Crown elongate, about as long as broad at the base. Forehead elongate, nearly twice as long as broad. Pronotum deeply incised posteriorly.

Length to apex of tegminæ 13.6 mm.

Holotype, female, Barro Colorado, July 1923, R. C. Shannon; collection of National Museum.

Tribe ALCESTISINI

In this tribe only a single genus *Alcestis* Stål, with 9 known species from South America, is recognized. The venation of this genus is peculiar. What appears to be subcosta and radius are united for a considerable distance from the base and far removed from the costal border, with subcosta having many branches to the costal border.

Tribe TAMBINIINI

In this tribe the tegminæ are transparent with a distinct costal area without cross veins.

This is the largest tribe of Tropiduchids in America. Twelve genera are known from North and South America and the West Indies.

Key to the American Genera of the Tribe Tambiniini

(Modified from Melichar)

A. Head with a distinct slender cephalic process.
    B. Cephalic process about as long as pro- and mesonotum combined; membrane with few cross veins....... *Athestia* Melichar 1914f: 71
    BB. Cephalic process longer than pro- and mesonotum combined; membrane with numerous cross veins. . *Remosa* Distant 1906n: 355
AA. Head more or less produced or spatulate but not with a distinct cephalic process.

B. Radius branched before the cross line.
 C. Media branched before the cross line *1*
  1. Forehead with a median carina only . . . . *Neurotmeta* Guerin-Meneville 1856a: 180
  1. Forehead with a median carina and a pair of intermediate carinæ . . . . *Rotunosa* Distant 1906n: 353
 CC. Media unbranched before the cross line . . . . *Tangidia* Uhler 1895a: 59

BB. Radius unbranched before the cross line.
 C. Media branched before the cross line *1*
  1. Forehead with a median carina; media branching near the base; cross line distinct . . . . . *Monopsis* Spinola 1839a: 302
  1. Forehead without a median carina; media branching near the cross line; cross line indistinct . . . . *Pelitropis* Van Duzee 1908d: 474
 CC. Media unbranched *1*
  1. Dorsal margin of the forehead incised; lateral margins of the crown strongly elevated . . . . *Cyphoceratops* Uhler 1901a: 510
  1. Dorsal margin of the forehead not incised; lateral margins of the crown not strongly elevated *2*
  2. Forehead impressed either side of the broad median carina *Tangiopsis* Uhler
  2. Forehead not impressed; median carina simple slender . . *3*
  3. Crown transverse with a simple median carina . . . . *Amapala* Melichar 1914f: 73
  3. Crown elongate, median carina branched caudad . . . . *Neotangia* Melichar 1914f: 77

Tangiopsis Uhl.

(Uhler 1901a: 512)

(*Rudia* Stål, *Temora* Kirkaldy, *Colgorma* Kirkaldy)

Haplotype *Tangiopsis tetrastichus* Uhler.

In a nomenclatorial way this genus has had a varied career. Kirkaldy proposed two new names for *Rudia* one of which was preoccupied. I have examined the type of *Tangiopsis* (Metcalf and Bruner 1930a: 397) but unfortunately did not recognize that this was the same as *Colgorma* Kirkaldy. A reexamination of the material convinces me that this is the case; hence *Tangiopsis* Uhler would replace *Colgorma* Kirkaldy.

This is a very distinct genus of the family TROPIDUCHIDÆ. The crown shades into the forehead which is elongate with a median

and lateral roll-like carinæ. The mesonotum is large, tricarinate. The tegminæ have few veins and cross veins; there are no costal cross veins. Subcosta, radius and media form a common stem on the basal fourth, the subcostal-radial stem and media are not branched before the subapical line; first cubital sector is forked before apex of clavus.

Six species are known from the West Indies, Central and South America.

Tangiopsis diluta Stål

Achilus dilutus Stål 1859b: 271.

There are three females in the present collection, Barro Colorado, 20 July 1924, N. B., and 9–12 November 1923, American Museum of National History, which belong to this species. It is uniform dull amber brown in color with transparent tegminæ with a yellowish cast and brown veins. This appears to be a color variety of this typical greenish species. The crown is nearly three times as long as broad, impressed; the lateral fovæ of the forehead are narrow and deep. The venation is typical and the hind tibiæ have four short stout spines and a fringe of stout bristles.

Tribe HIRACIINI

This is a small tribe of 15 known genera. Two genera are recognized from North America; *Grynia* Stål which has the body oval, the tegminæ with the veins distinct at the base and granulate at the apex, and *Gastrinia* Stål which has the body elongate oval with the venation simple on the base, reticulate apically.

Kirkaldy considered *Gastrinia* Stål preoccupied by *Gastrina* Guenee and proposed the new name *Amfortas*. I consider these names distinct on the basis of their spelling.

Family NOGODINIDÆ

Muir recently (1930c: 475) separated this group from the family RICANIIDÆ. He gives as his reasons: "This group has hitherto been included as a subfamily, tribe, or a part of the RICANIIDÆ. I have separated it as a distinct family, as the general facies as well as distinct morphological characters indicate. The two spines on the second hind tarsus, the frons longer than wide, and the lateral carinæ on the clypeus all distinguish it from the RICANIIDÆ. As the family stands at present it contains about forty genera and has greater affinity to the ISSIDÆ than to the RICANIIDÆ."

Key to the American Genera of the Family Nogodinidæ
(Modified from Melichar)

A. Head, including the eyes, wider than the pronotum.................. *Gaetulia* Stål 1864b: 54

AA. Head, including the eyes, never wider than the pronotum; sometimes a little narrower.

- B. Tegminæ coriaceous, or subhyaline.
  - C. Costal membrane broad; tegminæ large with numerous veins and cross veins..*1*
    - 1. Forehead with a median carina.............*Vutina* Stål
    - 1. Forehead without a carina....*Semestra* Jacobi 1916a: 309
  - CC. Costal membrane narrow; tegminæ narrow elongate........ *Bladina* Stål
- BB. Tegminæ hyaline.
  - C. Subcosta and radius forming a common stalk at the base of the tegminæ.............................*Biolleyana* Distant
  - CC. Subcosta and radius arising separately from the basal cell... *Nogodina* Stål

Nogodina Stål
(Stål 1862e: 70)

Logotype *Flata reticulata* Fabr., Schmidt 1919a: 157.

In this genus the forehead is longer than broad with the lateral margins elevated and a distinct percurrent median carina. The tegminæ are large; the costal membrane is crossed by numerous cross veins There is a single subapical line parallel to apical margin.

Nogodina reticulata Fabr.
Plates XI, XXII

Fabricius 1803a: 47.

Reticulata has a wide range from Central America to Brazil. There is a single specimen from British Guiana in the present collection but none from Barro Colorado.

Vutina Stål
(Stål 1862e: 70)

Logotype *Flatoides pelops* Walker.

In this genus the head is slightly narrower than the pronotum; the crown is short overlapped by the pronotum; the forehead is longer than

broad, the lateral margins parallel to the level of the antennæ and then converging to the narrower clypeus; median carina distinct sometimes not complete, lateral margins strongly elevated. Pronotum short, obtusely produced between the eyes. Mesonotum tricarinate. Tegminæ coriaceous, large; costal margin slightly sinuate in the stigmatal area; costal area broad with numerous simple cross veins; apical area with a simple submarginal line, and numerous longitudinal and cross veins. Hind tibiæ with three or four spines.

Four species and varieties are known from Central and South America. The following species seems to be very distinct.

Melichar gives *Ricania sexmaculata* Signoret as the type but this name was established (Stål 1862e: 70) for *Flatoides pelops* Walker and *Flatoides humeralis* Walker which belongs to *Vutina atrata* Fabricius. *Ricania sexmaculata* Signoret was not transferred to this genus until 1864 (Stål 1864b: 64), therefore, I cannot accept it as the type and have designated *Flatoides pelops* Walker as the type.

Vutina bipunctata spec. nov.

Plate XII

This species bears a superficial resemblance to *atrata* Fabricius (equals *feralis* Fowler) but may be distinguished at once by the black circular puncture on the basal third of the corium.

Crown very short, the pronotum almost reaching the anterior margin; median carina of forehead reaching only half way to clypeal suture. Median and lateral carinæ on clypeus conspicuous. Antennæ very short, the second segment globose. Pronotum very obtuse anteriorly; the posterior margin broadly emarginate. Mesonotum as broad as long. Tegminæ very broad about one and one half times as long as broad; costal margin very slightly sinuate apically; costal area broad, with numerous cross veins; numerous cross veinlets between subcosta and costa; subapical line about half as far from the apical margin as the greatest width of the costal area. A distinct circular impressed area on basal third of tegminæ between subcosta and media one; this area smooth and shining with the venation only faintly indicated. Hind tibiæ with three spines.

General color rich sepia clouded with fuscous. Forehead ivory white, with two fuscous transverse bands, one just above clypeal margin, the other on the dorsal margin. Clypeus and legs sepia. Cheeks and pleural pieces ivory yellow. Pro- and mesonotum and abdomen sepia. Tegminæ sepia clouded with fuscous with the black impressed mark al-

ready mentioned, behind the black mark there is an irregular ivory white semitransparent mark extending from subcosta to media one; another irregular ivory white mark on the apical angle and two narrow ivory white marks on the apical margin. There is a narrow pale fascia extending from near the base in front of the black punctures straight across the clavus to the commissural margin and another extending diagonally from the pale spot on the corium to the apex of the clavus.

Length to apex of tegminæ 14 mm.

Holotype, female, Barro Colorado, 16 February 1929, C. H. C.

Biolleyana Dist.

(Distant 1909f: 335)

Orthotype *Nogodina pictifrons* Stål.

This is a Central American genus which ranges southward into Northern South America. Its large transparent tegminæ with large costal area and numerous cross veins are suggestive of the family RICANIIDÆ but the other characters are those found in the NOGODINIDÆ.

Head about as broad as pronotum; crown transverse, separated from forehead by a distinct transverse carina; forehead long and narrow with complete lateral and median carinæ, and usually incomplete intermediate carinæ. Tegminæ rather broad, transparent, the veins and cross veins stout; costal membrane with many transverse veins; the apical area of tegminæ with three fairly regular transverse lines, one from stigma to apex of clavus bent basad, another parallel to apical margin extending from the stigma to the apex of the clavus, a third lying between these two.

Of the four species of this genus which may occur in Central America there is only one in the present collections.

Biolleyana costalis Fowl.

Plates II, XI, XXII

Fowler 1900g: 68.

This is the most abundant species in the present collections, being represented by numerous specimens. It is slightly variable in color, the tegminæ in some cases without fuscous marks and in other cases with a few fuscous marks, especially on the apical border. The stigma, in all the specimens which we have examined, is fuscous with an orange red center.

Bladina Stål

(Stål 1859a: 324)

Haplotype *Bladina fuscovenosa* Stål.

This is a Neotropical genus, one species ranging northward to Mexico.

This genus may be characterized briefly as follows: Head nearly as broad as pronotum, a distinct transverse carina between crown and forehead, forehead nearly quadrangular narrowed to clypeus, with a row of pustules along the lateral margins; forehead and clypeus with median and lateral carinæ. Tegminæ long and narrow, the costal area narrow, irregularly reticulate; media branched on the basal third, each sector with five or more main branches.

Bladina magnifrons Walk.

Plates XI, XXII

Poeciloptera magnifrons Walker 1858a: 56.

This species may be recognized by the general testaceous yellow color of the body and legs; the forehead fuscous with the pustules conspicuously paler or yellow. Tegminæ testaceous yellow with the veins fuscous, except the costal area which is fuscous with the reticular veins yellow. The structural characters may be observed in the illustrations.

There is a good series of this species in the present collections from Barro Colorado and various points in the Canal Zone by Mr. Banks and from Barro Colorado by Mr. Curran and Mr. Schwarz.

Family ACANALONIIDÆ

In this family the tegminæ are large, held vertical in repose. In these respects they resemble members of the family FLATIDÆ. They differ from the FLATIDÆ in lacking a costal area and in having the clavus not granulate. Acanalonids resemble Issids somewhat but the tegminæ are generally larger in the Acanolonids; the hind tibiæ are without spines.

This is a small family with eleven known genera; two of which, *Acanalonia* Spinola and *Philatis* Stål, have species known from Mexico and Central America. In *Acanalonia* the crown is broad usually broader than long; whereas in *Philatis* the head is conically produced, with the crown longer than broad.

There are no specimens of either genus in the present collections.

Family FLATIDÆ

This is a large family of nearly world wide distribution. The family was monographed by Melichar in 1901–1902 and again in 1923. I have followed Melichar's arrangement of subfamilies and tribes although Muir states that they are not natural. They are, however, very convenient and must serve until a better division is proposed.

Key to the Subfamilies and Tribes of the Family FLATIDÆ

(Modified from Melichar)

A. Tegminæ vertical or steeply tectiform..........Subfamily FLATINÆ
- B. Tegminæ broadly rounded apically.
  - C. Apical areas of the tegminæ beyond the apex of clavus very large...*1*
    - 1. Forehead concave Tribe SISCIINI (No American genera)
    - 1. Forehead flat or slightly convex......................*2*
    - 2. Costal cell short, more than twice as broad as the costal membrane..........................Tribe FLATINI
    - 2. Costal cell elongate, about as wide as costal membrane.... Tribe CERYNIINI
  - CC. Apical areas of the tegminæ beyond the apex of the clavus not large.....Tribe PHANTIINI (No Central American genera)
- BB. Tegminæ truncate or narrowed apically.
  - C. Tegminæ broadly triangular apical margin truncate.......*1*
    - 1. Sutural angle triangularly produced..Tribe FLATISSINI
    - 1. Sutural angle rounded not produced..Tribe NEPHESINI
  - CC. Tegminæ narrow, costal and apical margins sinuate........ Tribe SELIZINI

AA. Tegminæ horizontal or gradually tectiform...Subfamily FLATOIDINÆ

Subfamily FLATINÆ

In this subfamily the tegminæ are nearly vertical, with the costal membrane strongly developed with numerous cross veins.

Tribe FLATINI

In this tribe the tegminæ are very large with the apical margin broadly rounded, the costal cell is short and more than twice as broad as the costal membrane; the head is typically short, with the anterior margin of crown usually straight and transverse.

Only a single genus is recognized from America, *Poekilloptera* Latreille.

In establishing this tribe Melichar based the name on the genus *Phromnia* Stål, logotype *Cicada limbata* Fabricius. Unfortunately Duponchel (1840a: 205) had selected *limbata* as the type of *Flata* and *Phromnia* Stål will be a synonym of *Flata* Fabricius. For *Flata* Melichar (nec Fabricius), type *Cicada ocellata* Fabricius I propose the name *Flatissa*.

Poekilloptera Latr.

(Latreille 1796a: 90)

Haplotype *Cicada phalænoides* Linné, Latreille 1804a: 315.

This is a genus of common tropical American Flatids.

The head is small with a single transverse carina between the forehead and crown. The pronotum is short and broad; the lateral areas are elongate with a definite vertical carina. The mesonotum is large and inflated, ecarinate. The tegminæ are large; broadly rounded on the apical margin; irregularly reticulate over the entire surface; costal membrane narrower than the costal cell; costal cell short and broad. Legs relatively short and stout. Hind tibiæ with a single spine on the apical third.

Poekilloptera phalaenoides Linné

Plate XXII

Jacobi 1904b: 9.

This is the common Central and South American *Poekilloptera* with the head, thorax, legs and basal area of the costal margin ochraceous orange. Tegminæ white fading to light buff; irregularly sprinkled with round black dots, especially along the costal margin and claval suture.

Size very variable. Length to apex of tegminæ 15 — 23 mm.

Tribe CERYNIINI

This tribe contains two American genera *Adexia* Melichar and *Doria* Melichar. *Adexia* has a conspicuous subapical line in the corium and *Doria* has none.

Adexia Mel.

(Melichar 1901a: 229)

Logotype *Ormenis ermina* Fowl., Melichar 1923a: 27.

In this genus the head is small and the forehead narrow and elon-

gate. The tegminæ are large; broadly rounded apically with numerous straight transverse cross-veins; the apical area without cross veins except a single subapical line.

Adexia fowleri Mel.

Melichar 1901a: 230.

This species was described from Colombia. There is a single female from Barro Colorado, 24 December 1928, C. H. C.

The head, thorax and legs are dull black. The tegminæ are covered with whitish powder except the veins and cross veins which are black. The hind wings are white with the veins faintly fuscous. The abdomen is ochraceous orange with long white waxy filaments in the female.

Length to apex of tegminæ 20 — 22 mm.

Tribe FLATISSINI

This tribe includes two American genera *Hesperophantia* Kirkaldy n. n. for *Carthæa* Stål which has the forehead longer than broad, the tegminæ obliquely truncate; and *Carthæomorpha* Melichar which has the forehead as broad as long, tegminæ truncate but not obliquely.

Carthaeomorpha Mel.

(Melichar 1901a: 198)

Logotype *Carthæmorpha rufipes* Mel., Oshanin 1912a: 125.

Crown broad and short, nearly four times as long as broad; anterior and posterior margins nearly parallel, broadly curved; with a distinct carina separating the crown from forehead. Forehead slightly longer than broad; flat, lateral margins strongly elevated, broadly curved; median carina distinct dorsad. Tegminæ large; apex truncate; sutural angle strongly produced; venation reticulate; longitudinal veins distinct; costal cell broader than the costal membrane; media branched before the first cubital sector. Hind tibiæ with two spines on the apical third.

Carthæomorpha rufipes Mel.

Melichar 1902a: 34.

General color bright grass green fading to ochraceous orange. Carinæ of the head, anterior and intermediate tarsi and posterior tarsi

tinged with bright red. Commissural margin narrowly fuscous. A conspicuous row of fuscous granules along the second claval vein.

Two females, Barro Colorado, 27 June 1933, J. D. and H. Hood, in collection of National Museum; and Barro Colorado, 19 December 1928, C. H. Curran, in the American Museum of Natural History.

Tribe NEPHESINI

Melichar has recently (1923a: 62) established a number of new genera in this tribe based especially on species formerly included in the genus *Ormenis* Stål. As mentioned below this complex should be broken up. I have attempted to interpret Melichar's key and modified it to suit our American genera as far as they are known to me. Much more work must be done on this tribe before it is in satisfactory shape. The genera are complex and the characters are obscure. Students of the Homoptera are deeply indebted to Dr. Melichar for the fine preliminary work which he has done, but he would have been the last to assume that his work was complete, and the problem before us is to forward the work which he has so ably started.

Key to the American Genera of the Tribe NEPHESINI
(Modified from Melichar)

A. Two subapical lines on the corium.
   B. Anterior subapical line reaching, the posterior subapical line not reaching the costal margin............*Leptormenis* Melichar 1923a: 65
   BB. Both subapical lines reaching the costal margin.
      C. Very few of the longitudinal veins forked beyond the last subapical line......................................*1*
         1. Posterior tibiæ with two spines.....................*2*
         1. Posterior tibiæ with a single spine only................ *Petrusina* Melichar 1923a: 73
         2. Forehead as long as broad..........*Anormenis* Melichar
         2. Forehead distinctly broader than long................. *Flatormenis* Melichar
      CC. Most of the longitudinal veins beyond last subapical line forked..*1*
         1. Costal membrane broader than costal cell, apical and sutural angles equally rounded...................... *Ormenis* Stål (*Ormenoflata* Melichar)
         1. Costal membrane as broad as the costal cell, sutural angle angled..................*Ricanoflata* Melichar 1923a: 67

AA. One subapical line on the corium.
- B. Forehead broader than long . . . . *Monoflata* Melichar
- BB. Forehead longer than broad.
  - C. Few of the longitudinal veins forked beyond the subapical line *Ormenoides* Melichar 1923a: 73
  - CC. Most of the longitudinal veins forked beyond the subapical line . . . . *Melormenis* Metcalf

Ormenis Stål

(Stål 1862e: 68)

Logotype *Poeciloptera roscida* Germar.

Melichar has recently (1923a: 62 ff) divided this genus into a number of genera. This division has been needed for many years as the genus *Ormenis* had become a dumping place for a large number of species, with vague and indefinite characters. And since this separation should be made we will follow it for the present although we are by no means convinced that Melichar has always selected valid characters for the separations which he has made. Many of the characters he uses are vague and capable of several interpretations and others are not of generic value. But even accepting all his characters as valid and reliable, he has assigned some species to the wrong genera. However, the whole matter must be held in abeyance until a thorough study of all the chrotic and phallic characters can be made. He was not fortunate always in his selection of types and this matter I have attempted to straighten out in all cases.

Melichar selects as the type of *Ormenis, Cicada quadripunctata* Fabricius. This cannot be correct as *quadripunctata* was not included in the original description of this genus. As a matter of fact none of the species mentioned by Stål (1862e: 68) as belonging to *Ormenis* are included in the genus *Ormenis* of Melichar. I have selected *Poeciloptera roscida* Germar as the type of *Ormenis* Stål as it is the oldest included species. *Ormenis* Stål would replace *Ormenoflata* Melichar (1923a: 66), orthotype *Poeciloptera pulverulenta* Guerin-Meneville.

Ormenis roscida Germ.

Plate XXIII

Germar 1821a: 104.

I have followed Melichar (1902a: 64) in assuming that *roscida* Germar is the small species of *Ormenis* about 9—11 mm. long and

which is dark colored with the wings heavily powdered with blue and that *pulverulenta* Guerin-Meneville is the large species about 17 — 18 mm. long which is also dark colored. *Roscida* has been recorded previously from South America only, Dutch Guiana to Peru, Bolivia and Brazil. There is, however, a good series of specimens from Barro Colorado, 20 July 1924, N. B. and 18 July 1923 R. C. Shannon, in the present collections.

Melormenis nom. nov.

For the genus *Ormenis* Melichar (nec Stål) I would propose the nomen novum *Melormenis*. Orthotype *Cicada quadripunctata* Fabricius.

This genus has a wide distribution from Eastern North America through Mexico, Central America and the West Indies to Brazil and Argentina.

This genus may be characterized as follows: Face longer than broad, with a fairly distinct median carina; tegminæ with a single subapical line. This genus includes the common North American species *Flata pruinosa* Say and *Flata regularis* Fowler from Central America.

Melormenis regularis Fowl.

Flata regularis Fowler 1900f: 53.

I have seen no specimens that I could assign to this species. It is, from the figure and description in the Biologia, a small bright green species with the tegminæ narrowly infuscated along the costal and apical margins; the tegminæ are apparently elongate and narrow, with the face longer than broad.

Monoflata Mel.

(Melichar 1923a: 76)

Orthotype *Poeciloptera brasiliensis* Spinola.

This genus was established to include *Poeciloptera brasiliensis* Spinola from Brazil and *Ormenis pallescens* from Mexico. This genus is a very distinct genus of the *Ormenis* group with a fairly broad face with the lateral margins broadly arcuate, strongly elevated and united to the median carina by a fairly distinct transverse carina at the apex of the head. The tegminæ are distinctly widened apically,

venation very distinct, a single subapical line forming numerous apical cells about as long as the costal cells.

Monoflata banksi spec. nov.

Plate III

This is a very pretty little species testaceous green, perhaps bright green in life, with the lateral and dorsal margins of the face and the anterior and intermediate tibiæ narrowly lineate with black and the costal margin broadly and the apical margin less broadly margined with blackish fuscous. This species bears a superficial resemblance to *Ormenis nigromarginata* Melichar from South America, but it is much smaller. Melichar places *nigromarginata* in his genus *Anormenis* but the present species has none of the characters of that genus. Hence I conclude that it is specifically distinct.

Head broad, with the eyes broader than the pronotum. Vertex very short, with a rather distinct carina between it and the forehead. Forehead broad; the lateral margins distinctly arcuate; median carina short but distinct. Pronotum broadly arcuate; anterior border broadly subtruncate between the eyes; the posterior border broadly rounded. Mesonotum broad; indistinctly tricarinate. Tegminæ broad, widened apically; venation distinct; a single subapical line; apical cells numerous, about as long as the costal cells. Anterior and intermediate tibiæ distinctly carinate. Posterior tibiæ clavate; with two stout spines on the apical third.

General color testaceous green; the lateral carinæ, of the head, the posterior margin of the crown and the carinæ of the anterior and intermediate tibiæ narrowly lined with black. The costal margin of the tegminæ is broadly bordered with black for about half the width of the costal cell, the rest of the costal cell is ochraceous orange. The apical margin of tegminæ narrowly blackish fuscous this color being continued faintly around the inner apical angle to the apex of the clavus.

Length to apex of tegminæ 9.1 mm.

Holotype, female, Barro Colorado, 15 July 1924, N. B.

Anormenis Mel.

(Melichar 1923a: 68)

Orthotype *Poeciloptera tortricina* Germar.

This genus was described to include those American species of the group *Ormenis* which have the forehead as long as or longer than

broad, with the median carina percurrent or indicated dorsad only; and the tegminæ with two parallel subapical lines. The Central American species in this collection included in this genus are *media* Melichar and *discus* Walker both of which were described from South America; and *nigrolimbata* Fowler from Panama.

Key to Central American Species of ANORMENIS *Melichar*

A. Tegminæ fuscous with a large milky subhyaline spot near the costal margin before the first subapical line . . . . *discus* Walker

AA. Tegminæ chiefly pale.

- B. With a distinct fuscous spot at the apex of the clavus . . . . *nigrolimbata* Fowler
- BB. No fuscous spot at the apex of the clavus.
  - C. Costal margin of the tegminæ fuscous . . . . *inferior* Fowler 1900a: 58 (Mexico, Costa Rica)
  - CC. Costal margin of tegminæ not fuscous . . . . *media* Melichar

ANORMENIS MEDIA Mel.

Plates XVI, XXIII

Melichar 1902a: 89.

This species was described from Colombia. There is a single male in the present collection, Barro Colorado, 24 July 1924, N. B., which agrees with Melichar's short description except it is ochraceous orange in color with the veins more reddish, whereas the species was originally described as green. But pink variants of green Homoptera are common, hence we assume that this specimen is a pink color variety of *media*.

ANORMENIS DISCUS Walk.

Plates III, XII

Walker 1851a: 409.

This species was described from Brazil, but as far as we can determine the present specimen agrees with the description but is somewhat larger, 10 mm to apex of tegminæ. The species, *griseoalba* Fowler and *dolabrata* Fowler are very similar in coloration, but in *discus* the face is only as broad as long whereas in *dolabrata* and *griseoalba* the face is much broader than long. The elongate face with short but distinct median carina, fuscous tegminæ with large tranluscent spot on the costal border extending half way across the tegminæ will distinguish this species.

Anormenis nigrolimbata Fowl.

Fowler 1900f: 55.

This is a very distinct species with the face longer than broad; two parallel subapical lines about equidistant from each other and the apical margin. The general color is pale ivory yellow with a distinct black spot beyond the apex of the clavus; in one specimen there is a distinct fuscous margin from the apex of clavus around the apical margin to the costal border, in the other specimen this band is reduced to fuscous dashes between the longitudinal veins on the apical margin. Two females, Las Sabanas, 7 July 1924, and Ancon, 6 July 1924, N. B.

Flatormenis Mel.

(Melichar 1923a: 71)

Orthotype *Ormenis squamulosa* Fowler.

Melichar described this genus as having the forehead longer than wide but the context indicates that he really meant wider than long. In the species which I have identified as *griseoalba* Fowler and *panamensis* Schmidt the forehead is distinctly wider than long and Melichar places both these species in his genus *Flatornemis* (sic).

This genus may be characterized briefly as follows: Forehead broader than long; the lateral and clypeal margins distinctly raised; median carina fairly distinct. Tegminæ with two parallel subapical lines about equidistant from each other and from the apical margin, this distance greater than the width of the costal membrane. Few of the longitudinal veins beyond the last subapical forked.

Flatormenis griseoalba Fowl.

Plate XXIII

Fowler 1900g: 57.

There is a single male specimen in the present collection, Ancon, 6 August 1924, N. B., which agrees in essential details with Fowler's description. The dark costal margin is less definite than in Fowler's illustration and the apical dark margin is more distinct and about twice as broad, but otherwise the illustration agrees well enough.

Flatormenis panamensis Schm.

Plates III, XII, XXIII

Schmidt 1904b: 364.

This species appears to resemble *F. dolabrata* Fowler rather closely, but lacks the pale longitudinal vitta on the tegminæ, the pale spot on the corium is nearly circular in outline; the claval furrow is concolorous and the commissural margin is pale to the apex of clavus, where there is a distinct fuscous spot.

There is a single male in the present collection, Ancon, 8 August 1924, N. B., that agrees almost perfectly with Schmidt's description.

Flatormenis albescens Fowl.

Plate XXIII

Ormenis albescens Fowler 1900g: 57.

Structurally this species is close to *Flatormenis panamensis* Schmidt. The color, however, is entirely different. The head and thorax is tawny brown. The tegminæ are light buff with the costal and commissural margins tawny.

The genital styles short and broad, whereas in *panamensis* they are narrow and more elongate.

There is a single male specimen from Barro Colorado, November 1930, H. F. Schwarz in the American Museum of Natural History.

Tribe SELIZINI

In this tribe the genera have the tegminæ elongate, sometimes narrowed apically with the apical margin truncate or sinuate.

There has been some little confusion about the genus *Dascalia* Stål (1862e: 68). Stål originally included five species. Melichar (1902a: 142) included all but one of these species *convivus* Stål in the genus *Dascalia* and made *sinuatipennis* Stål the type. Subsequently Melichar (1923a: 101) made *sinuatipennis* the type of his new genus *Eudascalia* and made *grisea* Fabricius the type of *Dascalia* which he limited to species with the subapical lines parallel. *Eudascalia* is, therefore, a synonym of *Dascalia* and if these two genera are to remain separate *Dascalia* Melichar (nec Stal) with type *Cicada grisea* Fabricius must be renamed. I would suggest *Paradascalia*.

Key to the American Genera of the Tribe SELIZINI
(Modified from Melichar)

A. Sutural angle of the tegminæ not prolonged.
  B. Tegminæ broad at base, much narrowed caudad.
    C. Hind wings rudimentary .... *Mistharnophantia* Kirkaldy 1907i: 65
    CC. Hind wings well developed *1*
      1. Tegminæ slightly narrowed apically .... *Scarposa* Uhler 1895a: 72
      1. Tegminæ strongly narrowed apically *2*
      2. Tegminæ three or four times as long as broad, with the apical margin obliquely truncate .... *Cyarda* Walker 1858b: 121
      2. Tegminæ but little longer than broad, produced into an acute point .... *Rhynchopteryx* Van Duzee 1914a: 43
  BB. Tegminæ long and narrow not especially narrowed posteriorly.
    C. Tegminæ with two subapical lines *1*
      1. The two subapical lines broadly curved and parallel to the apical border *2*
      1. One or both subapical lines sinuate *3*
      2. Three longitudinal carinæ on the forehead .... *Paradascalia* Metcalf
      2. An oblique transverse carina at the base of the forehead.. *Anadascalia* Melichar 1923a: 103
      3. Anterior subapical line only sinuate *4*
      3. Both subapical lines sinuate .... *Pseudodascalia* Melichar 1923a: 102
      4. Forehead with three carinæ; base of the clavus strongly elevated .... *Dascalia* Stål 1862e: 68
      4. Forehead with a median carina only, sometimes not complete; base of clavus not elevated *5*
      5. Base of the forehead concave; apical margin of the tegminæ obliquely truncate .... *Dascalimorpha* Melichar 1923a: 103
      5. Forehead flat; apical margin of the tegminæ broadly sinuate .... *Leptodascalia* Melichar 1923a: 102
    CC. Tegminæ without a subapical line *Exoma* Melichar 1901a :200

AA. Sutural angle of the tegminæ prolonged but rounded.
  B. Posterior tibiæ with one spine .... *Neocerus* Melichar 1901a: 199
  BB. Posterior tibiæ with two spines.... *Eurocalia* Van Duzee 1907a: 40

Subfamily FLATOIDINÆ

The genera in this subfamily have the tegminæ nearly horizontal or gradually tectiform.

There has been much confusion in the use of generic names in this group. The genus *Flatoides* was first proposed by Guerin-Meneville (1844a: 362) for a species *tortrix* from Madagascar. Later Guerin-Meneville (1856a: 181 and 1857a: 431) described the new species *Flata* (*Phalænomorpha*) *tortrix* from Cuba and these two species have been considered the same by many subsequent writers. I have specimens of what I consider these species and they do not belong to the same genus. I have indicated therefore in the key the new genus *Pseudoflatoides* with *Flata tortrix* Guerin-Meneville as the type.

Many American species have since been described as belonging to the genus *Flatoides*. So far as the specimens in the present collections are concerned they fall into four genera; *Atracis* Stål (1866a: 250), logotype *Flata pyralis* Guerin-Meneville from the East Indies which may not be congeneric with our American species; *Flatarus* Melichar (1923a: 116), orthotype *Ricania corticina* Burmeister from South America; *Flataloides* Metcalf, orthotype *Elidiptera obliqua* Walker from Mexico; and *Flatoidinus* Melichar (1923a: 117), orthotype *Poeciloptera conviva* Stål from Brazil.

Key to the American Genera of the Subfamily FLATOIDINÆ

A. With a single spine on the posterior tibiæ . . . . *Atracis* Stål[1]
AA. With two spines on the posterior tibiæ.
- B. Crown longer than broad.
  - C. Costal margin of the tegminæ undulate, with two subapical lines . . . . *Pseudoflatoides* Metcalf
  - CC. Costal margin of the tegminæ not undulate, with a single subapical line . . . . *Flataloides* Metcalf
- BB. Crown as broad as long or broader.
  - C. Crown only as broad as long . . . . *Flatarus* Melichar 1923a: 116
  - CC. Crown broader than long . . . . *Flatoidinus* Melichar

ATRACIS Stål

(Stål 1866a: 250)

Logotype *Flata pyralis* Guerin-Meneville.

This is a genus in which certain Neotropical species have been placed. Our American species may be characterized as follows: Head

narrower than pronotum; crown usually as long as broad; antennæ with first segment half as long as second. Pronotum shorter than or as long as crown. Tegminæ large; costal membrane three or four times as broad as costal cell. Posterior tibiæ with a single spine on the apical third.

Atracis humeralis Walk.

Plates XII, XXIII

Walker 1858b: 70.

There is a single teneral male that we place as this species on the basis of the head characters.

Atracis quadripunctulus Fowl.

Flatoides quadripunctulus Fowler 1900g: 61.

This is a small olive green species with the veins irregularly marked with fuscous.

The crown is somewhat broader than long, broadly rounded anteriorly. The forehead is flat, with two conspicuous elevations dorsad.

There is a single female Barro Colorado, 11 January 1929, C. H. C. in the American Museum of Natural History which is smaller than Fowler's description indicates, but seems to agree otherwise.

Atracis pollutus Fowl.

Plate XXIII

Flatoides pollutus Fowler 1900g: 62.

This is a large pale greenish species which seems to fade to light buff. The tegminæ irregularly marked with blackish brown. The crown is longer than broad, obtuse anteriorly. The forehead is flat with two elongate elevations dorsad.

There is a single male from Barro Colorado, 9 December, M. Bates; Museum of Comparative Zoölogy.

Flataloides gen. nov.

Orthotype *Elidiptera obliqua* Walker.

This genus is quite similar to *Pseudoflatoides* Metcalf differing chiefly in having only a single subapical line on the tegminæ and the costal margin not undulate.

Head narrow produced; face smooth not carinate on the median

line; antennæ cylindric; first segment robust about half as long as second. Disc of pronotum flat, about as wide as head; anterior margin carinate; lateral fields with a distinct triangular process behind eyes. Mesonotum broad and flat, carinæ indistinct. Tegminæ very broad, held nearly horizontal; the costal membrane very broad, subcostal vein continued as a single subapical line to the apex of clavus. Hind tibiæ with two spines.

It is quite probable that many American species which have been assigned heretofore to *Flatoides* Guerin-Meneville should be assigned to this genus. If I identify *Flatoides tortrix* Guerin-Meneville correctly it is the type of a very distinct genus with undulate costa and two subapical lines.

Flataloides obliqua Walk.

Plate XXIII

Elidiptera obliqua Walker 1858a: 70; *Flatoides obliquus* Fowler 1900g: 64.

A large pale greenish species with a few small irregular fuscous spots, especially along the costal and subapical margin; the costal vein and the subapical line. The eyes are fuscous and there is a fuscous spot at the apex of the head and on the disc of the clypeus.

There is a pair in the National Museum from Barro Colorado. The male, 29 June 1933, Hood, Hood and Hook. The female 6 July 1923, R. C. Shannon.

Flatoidinus Mel.

(Melichar 1923a: 117)

Orthotype *Poeciloptera convivus* Stål.

In this genus the crown is broader than long but the head is narrower than the pronotum. The pronotum is about as long as the crown with the mesonotum broader than long. Forehead elongate. Tegminæ elongate; costal margin about twice as broad as costal cell; two irregular subapical lines, the second short. Hind tibiæ with two spines.

Flatoidinus occidentalis Walk.

Plates XII, XXIII

Elidiptera occidentals Walker 1851a: 331; *Flatoides isabellinus* Fowler 1900g: 63.

I have a single male from Taboga, Panama, 29 June, N. B. which agrees in essential details with Fowler's short description and illus-

tration. It is clay colored with small fuscous points on the pronotum, mesonotum and irregularly scattered on the tegminæ forming a more or less irregular band between the subapical lines and a regular row of spots on the apical margin in the cells.

Melichar (1923a: 113) placed *occidentalis* in *Flatoides* but if I have identified the species correctly it belongs in his genus *Flatoidinus*.

Family ISSIDAE

This is a large family of Fulgorids. In many genera the tegminæ are reduced and often much modified. Most of the species are small or very small.

Key to the Subfamilies and Tribes of the Family Issidæ

A. Tegminæ short and only reaching slightly beyond the base of abdomen, or exceedingly narrow, parchment-like, thick or opaque, seldom hyaline; wings absent or rudimentary............Subfamily CALISCELINÆ

AA. Tegminæ entirely covering the abdomen or the greater portion of it.

- B. Clavus and corium not separated by a suture. Tegminæ generally convex, thick, and the venation obscure......................
  Subfamily HEMISPHÆRINÆ (No American genera)
- BB. Clavus separated from corium by a suture....Subfamily ISSINÆ
  - C. Wings absent, or rudimentary, not folded.................
    Tribe HYSTEROPTERINI
  - CC. Wings present.......................................*1*
    - 1. Wings with margins entire, anal area not enlarged.......
      Tribe ISSINI
    - 1. Wings with a deep cleft in the apical margin, the anal area very large........................Tribe THIONIINI

Subfamily CALISCELINÆ

Representatives of two genera *Bruchomorpha* Newman and *Fitchiella* Van Duzee have been reported from Central America but there are no specimens in the present collections. Both genera occur in North America. These genera may be distinguished from each other by the fact that the anterior and middle tibiæ are expanded in *Fitchiella* and simple in *Bruchomorpha*.

Subfamily ISSINÆ

This is the largest subfamily of the family ISSIDÆ. As a general thing the head is not much modified. The tegminæ are fairly well de-

veloped but much modified with the venation much reduced and frequently reticulate. The claval furrow is distinct and the hind wings are present or absent.

Tribe HYSTEROPTERINI

This tribe includes those genera which have the hind wings absent or greatly reduced. For the most part these genera reach their best development in the arid regions of the world.

Key to the Genera of the Tribe Hysteropterini *Known to Occur in Mexico and Central America*[1]

A. Tegminæ horizontal with transparent areas .... *Dictyssa* Melichar 1906a: 163

AA. Tegminæ vertical without transverse areas.

- B. Dorsal margin of the forehead straight .... *Hysteropterum* Amyot and Serville 1843a: 519
- BB. Dorsal margin of the head deeply triangularly incised .... *Traxus* Metcalf 1923a: 189

Tribe ISSINI

In this tribe are included those genera which have the hind wings well developed with a small anal fold which is not separated from the rest of the wing by an anal incision. The various genera are widely distributed in the principal zoo-geographic regions of the world. For the most part they are monotypical or contain very few species.

Key to the Genera of the Tribe Issini *Known to Occur in Mexico and Central America*

A. Head produced into a distinct cephalic process .... *Proteinissus* Fowler 1904c: 121

AA. Head rounded before not produced into a distinct cephalic process.

- B. Tegminæ elongate, costal margin sinuate apically, humeral angles not strongly produced .... *Colpoptera* Burmeister
- BB. Tegminæ scarcely longer than broad, costal margin not sinuate.
  - C. Humeral angles of tegminæ strongly produced; tegminæ not falcate .... *Ulixes* Stål 1862e: 67
  - CC. Humeral angles of tegminæ not produced; tegminæ falcate ... *Hypancylus* Fowler 1904c: 114

[1] In addition to these genera several others are found in the arid Southwest which undoubtedly extend into Mexico.

COLPOPTERA Burm.

(Burmeister 1835a: 155)

Logotype *Colpoptera sinuata* Burm.

This genus has been placed in various families. Melichar (1923a: 91) placed it in the FLATIDÆ, tribe SELIZINI next to the genus *Cyarda* which it superficially resembles. It belongs, however, in the ISSIDÆ, tribe ISSINI and has the broad head, the short pronotum with the lateral margins behind the eyes very short; typical tegminæ and the entire wings found in this group.

Key to the Species of COLPOPTERA *Burmeister*

A: Crown narrow, elongate, longer than broad.
- B. Lateral margins of forehead reflexed, median carina distinct...... *rugosa* Van Duzee 1907a: 36 (Jamaica)
- BB. Lateral margins of forehead only slightly elevated, median carina indistinct............*elevans* Walker 1858c: 335 (Haiti, Jamaica)

AA. Crown broader than long.
- B. Length to apex of tegminæ 5 — 6 mm.
  - C. Crown truncate anteriorly, forehead dark with lighter median spot..............*brunneus* Muir 1924g: 465 (West Indies)
  - CC. Crown arcuate anteriorly, forehead with a double row of lighter spots.....*maculifrons* Muir 1924g: 466 (West Indies)
- BB. Length to apex of tegminæ 8 or more mm.
  - C. Tegminæ with a stigmatal spot dark brown............... *sinuata* Burmeister 1835a: 135 (Mexico)
  - CC. Stigmatal spot pale, translucent......*marginalis* Burmeister

COLPOPTERA MARGINALIS Burm.

Plates III, XII, XX

Burmeister 1835a: 156.

This is a large dark colored species with a large milky subhyaline spot on the costal margin and a small milky subhyaline spot on the sutural margin beyond the apex of the clavus.

There is an extensive series in the present collection taken at various points in the Canal Zone during July.

Tribe THIONIINI

The genera of this tribe have the hind wings well developed with a large anal fold which is frequently larger than the rest of the wing and

is separated from the rest of the wing by a distinct anal incision. This tribe contains several distinctly American genera.

Key to the Genera of the Tribe THIONIINI *Known to Occur in Mexico and Central America*

A. Hind tibiæ with two spines on the distal end.
  B. Median carina of the forehead or of forehead and clypeus strongly cristate.
    C. Forehead only cristate . . . . *Thioniella* Metcalf
    CC. Both forehead and clypeus cristate *1*
      1. Crown and forehead narrow elongate, cristæ short triangular . . . . *Thionissa* Metcalf
      1. Crown and forehead broad; cristæ elongate . . . . *Thioniamorpha* Metcalf
  BB. Median carina of the forehead and clypeus simple not cristate. . . . *Thionia* Stål
AA. Hind tibiæ with four or five spines more or less uniformly distributed from proximal to distal ends . . . . *Picumna* Stål

THIONIA Stål

(Stål 1859a: 321)

Logotype *Issus longipennis* Spin., Van Duzee 1916a: 81.

This is a large genus with 61 known species from North, Central and South America. In this genus the body is generally elongate oval, with the head broad, forehead broad with generally a distinct median and intermediate carinæ, the lateral areas with pustules. The tegminæ are elongate with simple longitudinal veins; media usually branching on the basal third; and all the veins connected by cross veins. The hind wings are large with the anal fold very large and folded on itself.

The chrotic characters used to separate the species are rather vague and very hard to define but the phallic characters seem to be reliable. But unfortunately I have not had an opportunity to examine the males of all species.

Key to the Species of THIONIA *Known from Mexico, Central America and Northern South America*
(Modified from Melichar)

A. Crown broader than long.
  B. Body more or less elongate.
    C. Forehead longer than broad, narrowed between the eyes . . . *1*

1. Tegminæ with brown or black spots *2*
1. Tegminæ uniformly colored without spots . . . .
prasina (Spin.) Melichar 1906a: 273 (Brazil)
2. Forehead arched . . . .
dissimilis Schmidt 1910c: 206 (Colombia)
2. Forehead not arched . . . .
variegata (Stål) Melichar 1906a: 272 (Mexico)

CC. Forehead as broad as long, quadrangular . . . .
stipes Fowler 1905a: 127 (Panama)

BB. Body broad or oval.

C. Pronotal plates with a conspicuous impressed black spot . . . *1*
1. Forehead with a transverse ruga dorsad . *crucifera* Metcalf
1. Forehead without a transverse ruga dorsad *2*
2. Forehead with a conspicuous transverse blackish fascia. . .
schmidti Schmidt 1910c: 207 (Costa Rica)
2. Forehead without a transverse fascia . . . . . . *brevior* Fowler

CC. Pronotal plates without a conspicuous impressed black spot *1*
1. Forehead elongate . . . *humilis* Fowler 1904c: 124 (Mexico)
1. Forehead subquadrate *2*
2. Tegminæ spotted with black *3*
2. Tegminæ uniformly colored . . . .
coriacea (Fabr.) Stål 1869a: 102
3. Humeral callosities of the tegminæ strongly elevated. . . . .
fowleri Metcalf
3. Humeral callosities not strongly elevated *4*
4. Intermediate carinæ of forehead forming a closed oval . . .
obtusa Melichar 1906a: 279 (Mexico)
4. Intermediate carinæ indistinct not forming a closed oval . . *5*
5. On the crown a black circular mark . . . .
maculata Melichar 1906a: 279
5. Tegminæ marked with pale fasciæ or spots *6*
6. Tegminæ with a distinct transverse pale fascia . . . .
ovata Melichar 1906a: 280 (Brazil, French Guiana)
6. Tegminæ with irregular pale spots not forming a transverse fascia . . . . *onerata* Melichar 1906a: 280 (Venezuela)

AA. Crown as long as broad or longer.

B. Forehead slightly arched transversely.

C. Forehead with a bright yellow transverse band . . . .
transversalis Melichar

CC. Forehead without a conspicuous transverse band *1*
1. Basal margin of the forehead deeply excavated between the eyes . . . . *caviceps* Fowler 1905a: 125 (Panama)

1. Basal margin of the forehead not or only slightly excavated between the eyes *2*
2. Vertex as long as broad . . . . *pehlkei* Schmidt 1910c: 198 (Colombia)
2. Vertex elongate, produced, two or more times as long as broad . . . . *naso* Fowler 1904c: 124 (Mexico)

BB. Forehead nearly flat transversely.

C. Median carina of forehead pectinate . . . . *carinata* Melichar 1906a: 281 (Nicaragua)

CC. Median carina of forehead not pectinate *1*

1. Apex of the femora with a black spot . . . . *maculipes* Melichar 1906a: 282 (Mexico)
1. Apex of femora without a black spot *2*
2. Vertex roundly produced anteriorly *3*
2. Vertex angularly produced anteriorly *6*
3. Pronotal shields with a large black spot bordered with white . . . . *impressa* Melichar 1906a: 284 (Jamaica)
3. Pronotal shields without a black spot *4*
4. Forehead black with conspicuous yellow spots . . . . *pictifrons* Fowler 1905a: 125 (Mexico)
4. Forehead not black with conspicuous yellow spots *5*
5. Forehead elongate, narrowed between the eyes . . . . *herbacea* Melichar 1906a: 285 (French Guiana)
5. Forehead short and broad, not narrowed between the eyes *sordida* Fowler 1904c: 124 (Mexico)
6. Vertex 5-angled, the lateral margins diverging anteriorly . . *soluta* Fowler 1905a: 126 (Panama)
6. Vertex quadrilateral, lateral margins parallel *7*
7. Tegminæ strongly spotted with black *8*
7. Tegminæ uniformly colored, an oblique transverse dark band before the middle *9*
8. Lateral areas of the forehead black, with light colored granules . . . . *colombiæ* Melichar 1906a: 284 (Colombia)
8. Lateral areas of the forehead light, with dark granules . . . *mexicana* Melichar 1906a: 285 (Mexico)
9. Mesonotum with a row of dark points along the lateral borders. Length 6 mm . . . . *scutellata* Fowler 1904c: 123 (Mexico)
9. Mesonotum without a row of dark points along the lateral borders. Length 4.5 mm . . . . *truncatella* Melichar 1906a: 284 (Mexico)

Thionia transversalis Mel.

Plates XII, XIII

Melichar 1906a: 281.

This species was described from North America. There are two specimens in this collection which agree in essential details.

The crown is about as broad as long. The forehead is quadrangular; strongly arched transversally with the median carina strongly elevated dorsad and the intermediate carinæ fading out on the lower half; a distinct transverse yellow band on the upper half bordered dorsad with fuscous.

Thionia coriacea Fabr.

Plate XII

Stål 1869a: 102.

A single badly mutilated male specimen from Barro Colorado, 15 July 1924, N. B., is placed here with considerable hesitation. This species was described from females from Para and Brazil. The present example agrees very well with the description in all major points. The crown is about twice as long as broad; the forehead is dark fuscous; and the tegminæ uniformly brown.

Thionia carinata Mel.

Plate XIII

Melichar 1906a: 281.

There is a single female Barro Colorado, 25 July 1924, N. B., which agrees in all essential details. The crown is as long as broad; the forehead quadrangular the lateral margins nearly straight, the median carina percurrent, pectinate dorsally, the lateral row of pustules very conspicuous, bright yellow in color; the tegminæ expanded basally giving an oval appearance.

Thionia brevior Fowl.

Plates III, XIII

Fowler 1904c: 123.

A single female, Fort Davis, Canal Zone, 5 July 1924, N. B., which agrees with Fowler's short description and illustration in every particular save that no mention is made of the conspicuous round black spot on the pronotal plates. The tegminæ are inflated basally as shown

in the illustration; the crown is broad; the median frontal carina is incomplete, extending from the dorsal margin for about a third of the length of the forehead, with two indefinite diagonal fascia one starting at the middle of clavus and extending fairly definitely to the costal margin, the other starting at the apex of clavus and extending towards the apical angle.

Thionia crucifera spec. nov.

Plates XIV, XIX

This is a small oval species with a transverse crown, about twice as broad as long; with the posterior border deeply incised; and the posterior lateral areas deeply impressed. Forehead nearly as broad as long with a short but distinct median carina and a distinct transverse ruga dorsally.

Length to apex of tegminæ 4.5 mm.

Holotype, male, Barro Colorado.

Thionia fowleri nom. nov.

For *Thionia conspersa* Fowler 1905a: 125 (nec *Thionia* (*Issus*) *conspersa* Walker 1851a: 365) which seems to be a variety of *Thionia bullata* Say.

Thioniella gen. nov.

Orthotype *Thioniella rugosa* spec. nov.

This genus resembles *Thionia* Stål rather closely but differs in head characters and venation.

Head narrower than pronotum; crown slightly longer than broad, the lateral margins elevated and diverging anteriorly, the median line sulcate, anterior margin produced; forehead nearly as broad as long, produced above into an elongate triangular cristate callosity, the lateral margins below inflated into rounded slightly elevated callosities; clypeus elongate, medially carinate. Pronotum short and broad; posterior margin broadly sinuate; carinæ strongly diverging; two deeply impressed points near the median line; lateral fields of pronotum with four slightly elevated callosities. Mesonotum short and broad with a distinct transverse carina back of anterior margin. Tegminæ strongly rugulose. Venation not evident, subcosta, radius and first cubital sector unbranched, media bifurcate close to basal cell. Hind tibiæ with two spines on the apical third.

Thioniella rugosa spec. nov.

Plates III, XIII

Crown about as long as greatest width, two elongate impressed points either side of median sulcus at the base, diverging anteriorly. Forehead about as broad as long, narrowed above; the median dorsal callosity robust, somewhat pyramidal. Clypeus with a distinct median carina. Second segment of antennæ slightly longer than broad, cylindric. Pronotum with diverging carinæ following the contour of the head; with large oval callosities behind the diverging carinæ and two impressed points at the middle near the median line; posterior margin broadly sinuate. Mesonotum about as long as pronotum. Tegminæ strongly and coarsely rugulose, with a deeply impressed oval area on the basal angles, shoulders strongly elevated. Hind tibiæ with two spines on the apical half.

General color ochraceous tawny shading to ochraceous buff, irregularly marked with fuscous and testaceous. Head largely ochraceous tawny marked with ochraceous buff, with the carinæ and the clypeus irregularly marked with fuscous. Eyes and antennæ fuscous. Tegminæ largely ochraceous tawny with three irregular transverse fuscous fasciæ, one near the base, one before the middle and the other before the apex. Wings blackish fuscous, veins black. Anterior and middle femora and tibiæ ringed with tawny and buff; hind femora and tibiæ lineate with fuscous. Abdomen below tawny, the central area clouded with fuscous; and the pleural pieces red.

Length to apex of tegminæ 14.7 mm.

Holotype, female, Barro Colorado, 20 July 1924, N. B.

Thionissa gen. nov.

Orthotype *Thionissa acuta* spec. nov.

This genus has the general characters of *Thionia* Stål, but the median frontal carina is elevated into a prominent callosity. In this respect it resembles *Thioniella* Metcalf but the crown and forehead are narrow in *Thionissa* and the clypeus is elevated on the median line into a prominent cristate carina.

Head, including eyes, narrower than pronotum; crown narrow, lateral margins strongly elevated; forehead narrow, lateral margins strongly elevated, median carina strongly developed and triangularly cristate, two small lateral callosities near the clypeal margin; clypeus

cristate the median carina when viewed laterally broadly rounded. Tegminæ rather broad, nearly quadrangular, shoulders strongly produced, venation rather simple, the longitudinal veins connected by numerous cross veins; subcosta radius and first cubital sector unbranched, media four branched. Hind tibiæ with two spines.

THIONISSA ACUTA spec. nov.

Plates XIV, XV, XIX

Crown more than three times as long as broad, faintly sulcate on the median line, sulcus deeply impressed on the anterior third. Forehead narrow distinctly narrowed between the eyes; dorsal callosity narrow triangular strongly produced; a pair of oval callosities on either side of the median carina at about the level of the antennæ. Median clypeal carina strongly cristate, the crista when viewed laterally broadly rounded. Pronotum shorter than mesonotum, disc of both smooth, ecarinate. Tegminæ with simple cross veins.

General color ochraceous buff heavily and irregularly marked with fuscous and testaceous. Carinæ of head and the surface of the forehead and clypeus largely fuscous. In some specimens the tegminæ are almost completely fuscous in others marked with irregular clouds of fuscous. Wings fuscous. Femora all once or twice ringed with testaceous, anterior and intermediate tibiæ similarly marked. Abdomen largely fuscous.

Length to apex of tegminæ 8.5 — 10 mm.

Holotype, male, Barro Colorado, 10 November 1930, H. F. Schwarz, American Museum of Natural History.

Paratypes, one male, Barro Colorado, 3 April 1929, S. W. Frost; one male, Barro Colorado, 5 July 1905, W. Robinson; one specimen sex not determined, Santa Carlos, Costa Rica, Schaus and Barnes, all in the U. S. National Museum.

THIONIAMORPHA gen. nov.

Orthotype *Thioniamorpha marmorata* spec. nov.

This genus resembles *Thionissa* Metcalf in a general way but the head is much broader and differs in other characters and the venation is different.

Head broad, nearly as broad as the pronotum; crown rather narrow, concave, the lateral margins well elevated; forehead narrowed between

the eyes, lateral margins elevated, median carina strongly developed, median callosity not developed not raised above the level of the median carina; ventral callosities conspicuous. Clypeus tricarinate, the median carina moderately cristate. Pronotum transversely impressed across the middle, with two minute punctures close together; lateral fields smooth. Mesonotum with distinct median and transverse carinæ forming a conspicuous T-shaped mark. Legs simple. Hind tibiæ with two stout spines on the apical half. Tegminæ quadrangular, inflated at the base; venation distinct, cross veins reticulate; subcosta, radius, media and first cubital sector arising from the basal cell, radius two branched on apical area, media with two sectors arising on the basal fifth, the first sector with three distinct branches apically, second medial sector unbranched, first cubital sector unbranched, hind wing with a broad anal fold.

Thioniamorpha marmorata spec. nov.

Plate XIV

General color dull ferrugineous. Crown and forehead ochraceous buff, heavily marked with fuscous. Tegminæ heavily marked with fuscous especially along the apical and sutural margins.

Length to apex of tegminæ 9.2 mm.

Holotype, female, Barro Colorado, 10 November, H. F. Schwarz, American Museum of Natural History.

Picumna Stål

(Stål 1864a: 52)

Logotype *Picumna varians* Stål, Van Duzee 1916a: 81.

[Includes *Cyclumna* Fowler 1904c: 116, haplotype *Cyclumna subrotundata* Fowler; and *Issomorphus* Melichar, logotype *Issomorphus maculatus* Van Duzee 1916a: 81.]

I have placed these three genera together because I have been unable to find any reliable characters to separate them. Melichar separates *Picumna* and *Cyclumna* from *Issomorphus* on the basis that the former group has four spines on the hind tibiæ while *Issomorphus* has five. In the former group the first cubital sector is forked in the middle of the corium while in *Issomorphus* the first cubital sector is unbranched. I believe that *Cyclumna* represents forms with short tegminæ while *Picumna* has slightly longer tegminæ and *Issomorphus* still longer.

One of the specimens in the present collection has five spines on one hind tibia and four on the other, while the first cubital sector is branched at the level of the union of the claval veins and the tegminæ are short and the body broadly oval.

Picumna subrotundata Fowl.

Plates III, XIV

Fowler 1904c: 116.

This is a light ochraceous buff species with two broad blackish fuscous fasciæ on the tegminæ, one near the base and the other beyond the middle. The anterior half of the crown, the disc of the pronotum and two longitudinal vittæ on the mesonotum are also blackish fuscous.

There is a single female from Mt. Hope, Canal Zone, 8 July 1924, N. B., in the Museum of Comparative Zoölogy.

Picumna testacea spec. nov.

Plates III, XIV, XIX

This species differs from *subrotundata* not only in color but in the following structural characters: Crown broader, less elongate; much smaller; pronotum longer and less angulate; face narrower, more elongate, median carina less elevated.

Crown quadrangular, fovea small. Forehead elongate, distinctly narrowed between the eyes. Pronotum short; posterior margin nearly straight. Mesonotum slightly longer than pronotum. Subcostal radial stem very short; media forked on the basal third; first medial sector again forked before apex; first cubital sector forked on the level with the union of the claval veins.

General color honey yellow. Tegminæ with a few fuscous spots and with slight irregular fuscous cloudings. Crown with the anterior margin blackish fuscous, the disc of the pronotum and two vittæ on the mesonotum of the same color.

Length to apex of tegminæ 5.5 mm.

Holotype, male, Las Sabanas, Panama, 7 July 1924, N. B.

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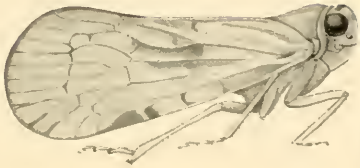
EXPLANATION OF PLATES

PLATE 1

PLATE 1

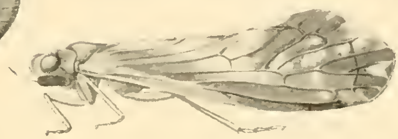
Adult Cixiidae, Derbidae and Araeopidae from Central America.



Pintalia germans Fowl.

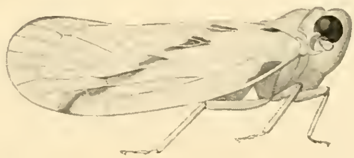
Mysidia costata Fab.

Pintalia tacta Fowl.

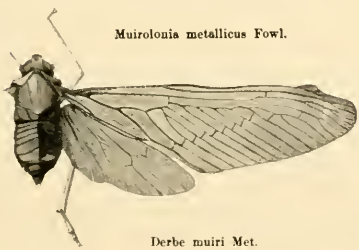


Amalopota fitchi Van D.

Muirolonia metallicus Fowl.



Syntames delicatus Fowl.



Derbe muiri Met.

Persis fuscinervis Muir.

Eucanyra stigmata Craw.

Neocenchrea pallescens Met.

PLATE 2

PLATE **2**

Adult Achilixiidae, Achilidae and Nogodinidae from Central America.

Muirilixius banksi Met.

Catonia sobrina Fowl.

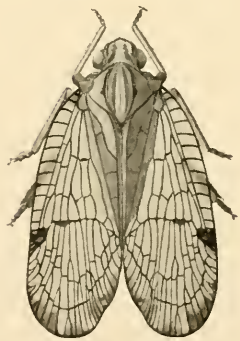
Ateson marmoratum Met.

Muirilixius banksi Met.

Elidiptera callosa Spin.

Ateson fuscum Met.

Koloptera callosa Met.



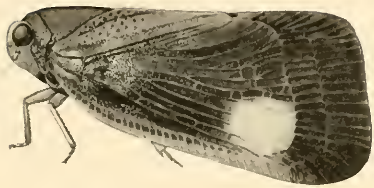
Biolleyana costalis Fowl.

PLATE 3

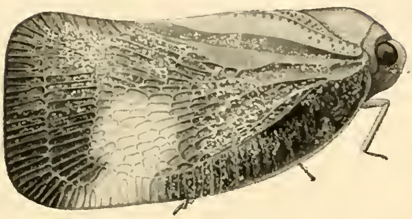
PLATE **3**

Adult Flatidae and Issidae from Central America.

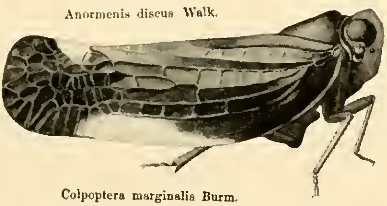
Monoflata banksi Met.



Flatormenis panamensis Schmidt



Anormenis discus Walk.



Colpoptera marginalia Burm.

Thioniella rugosa Met.

Thionia brevior Fowl.

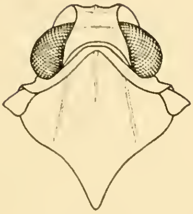
Picumna subrotundata Fowl.

Picumna testacea Met.

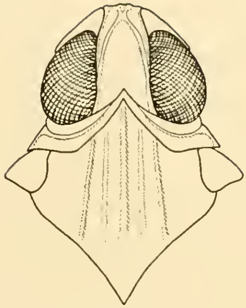
PLATE 4

PLATE 4

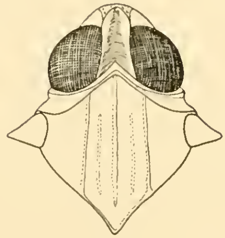
Dorsal and frontal views of head and thorax of Central American Cixiidae, Araeopidae and Derbidae.



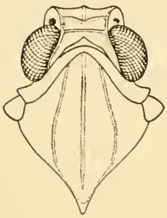
Pintalia germana Fowl.



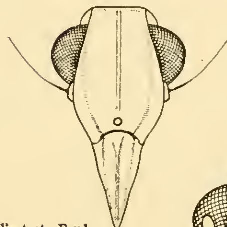
Oliarus excelsus Fowl.



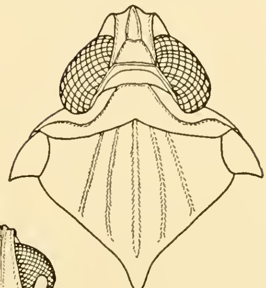
Oliarus omani Met.



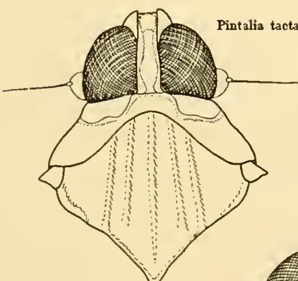
Pintalia tacta Fowl.



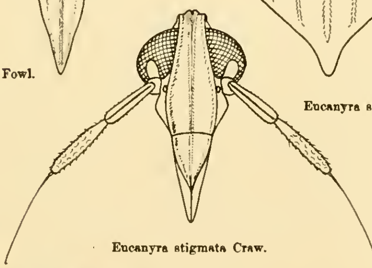
Pintalia tacta Fowl.



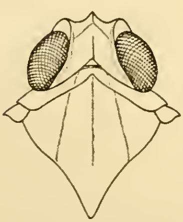
Eucanyra stigmata Craw.



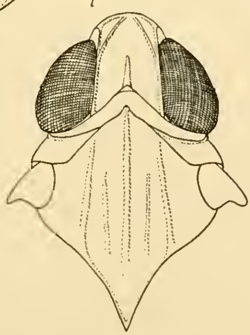
Oecleus concinnus Fowl.



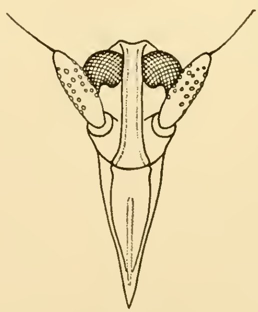
Eucanyra stigmata Craw.



Muirolonia metallicus Fowl.



Oliarus concinnus Fowl.

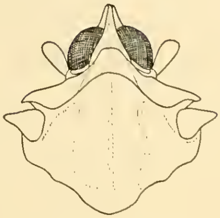


Mysidia costata Fab.

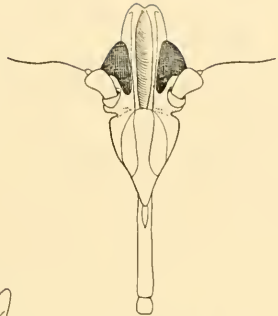
PLATE 5

PLATE 5

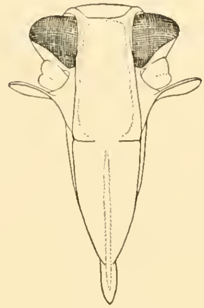
Dorsal, lateral and frontal views of Central American Derbidae.



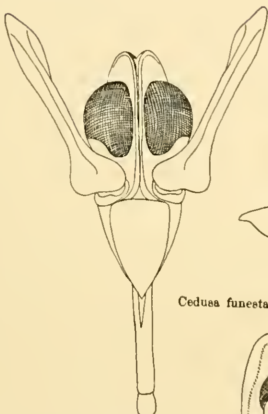
Pseudomyaidia fuscovaria Met.



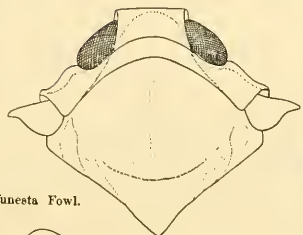
Persia fuscinervia Muir.



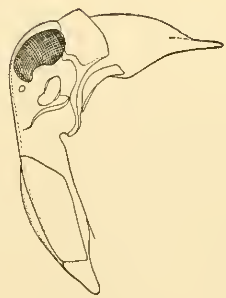
Cedusa funesta Fowl.



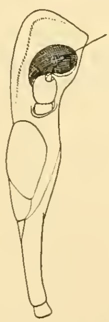
Platonax maculata Met.



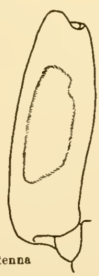
Cedusa funesta Fowl.



Cedusa funesta Fowl.

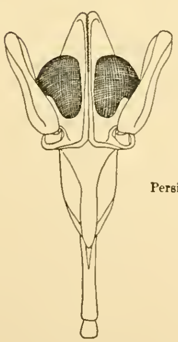


Persia fuscinervia Muir.

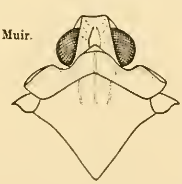


Antenna

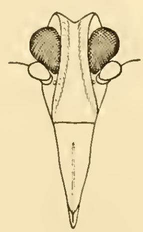
Platonax maculata Met.



Anotia punctata Met.



Syntames fulva Van D.

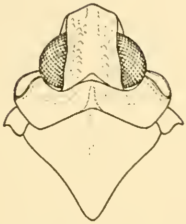


Syntames fulva Van D.

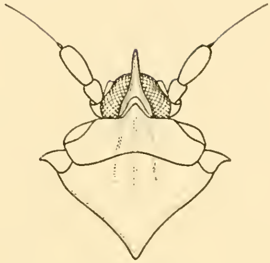
PLATE 6

PLATE 6

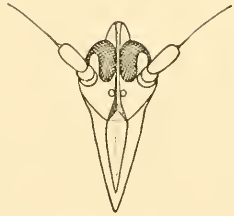
Dorsal and lateral views of Central American Derbidae, Achilixiidae and Dictyopharidae.



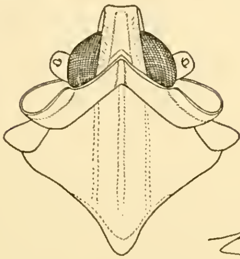
Syntames albida Met.



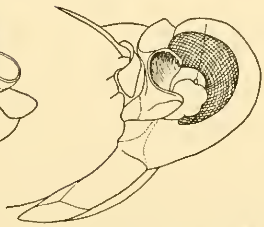
Muirilixius banksi Met.



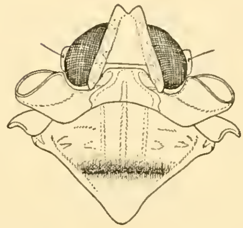
Muirilixius banksi Met.



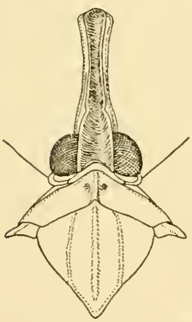
Neocenchrea pallescens Met.



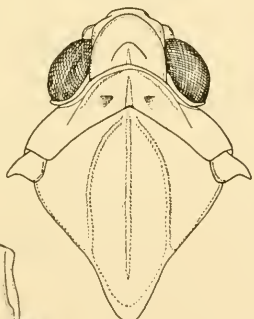
Neocenchrea pallida Met.



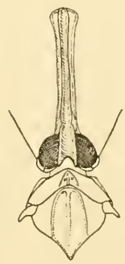
Neocenchrea pallida Met.



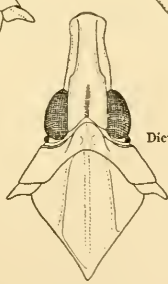
Lappida fusca Met.



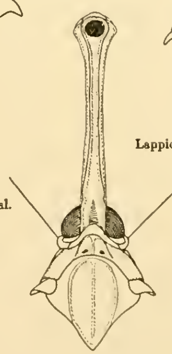
Dictyophara nigronotata Stal.



Lappida rubrovitta Met.



Lappida cholorochroma Walk.

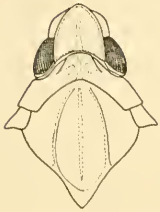


Lappida ferocula Dist.

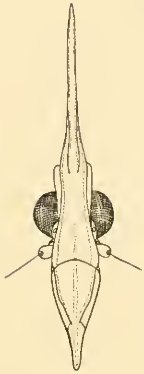
PLATE 7

PLATE 7

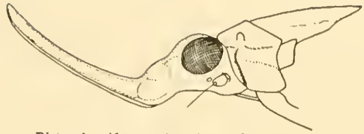
Dorsal, lateral and frontal views of Central American Dictyopharidae, Fulgoridae and Achilidae.



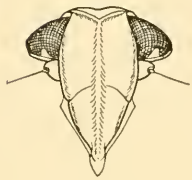
Dictyophara herbida Walk.



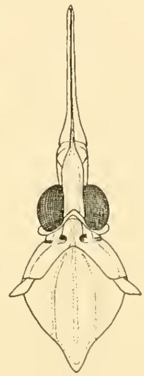
Dictyopharoides tenuirostris Fowl.



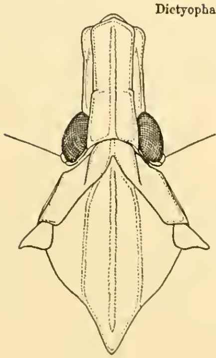
Dictyopharoides tenuirostris Fowl.



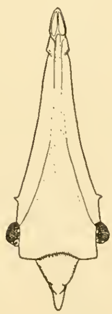
Messeia asper Fowl.



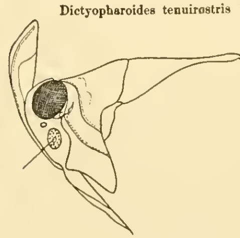
Dictyopharoides tenuirostris Fowl.



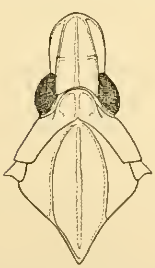
Dictyophara brachyrhina Walk.



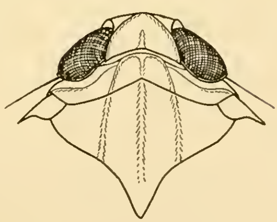
Odontoptera carrenoi Sign.



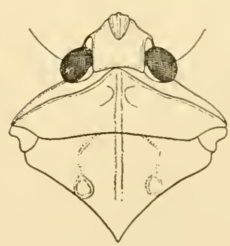
Copidocephala ornando Dist.



Dictyophara obtusifrons Walk.



Messeis asper Fowl.

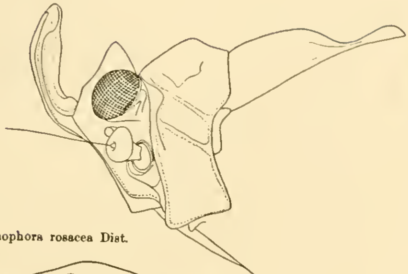


Copidocephala ornando Dist.

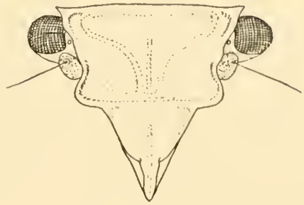
PLATE 8

PLATE 8

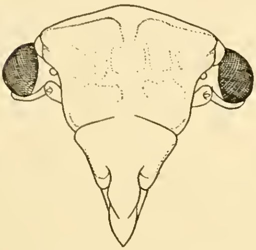
Dorsal, lateral and frontal views of Central American Fulgoridae and Achilidae.



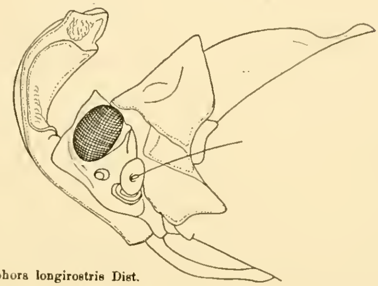
Enchophora rosacea Dist.



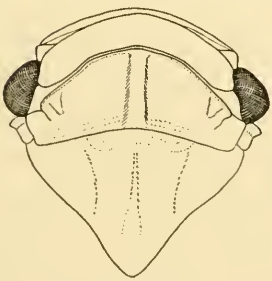
Crepusia ornata Met.



Calyptoproctus elegans Spin.

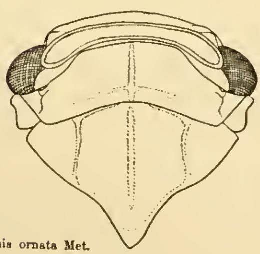


Enchophora longirostris Dist.

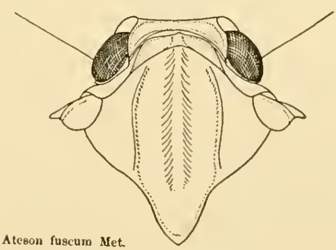


Calyptoproctus elegans Spin.

Enchophora sanguinea Dist.



Crepusia ornata Met.

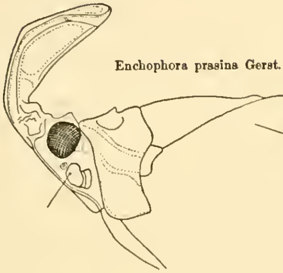


Ateson fuscum Met.

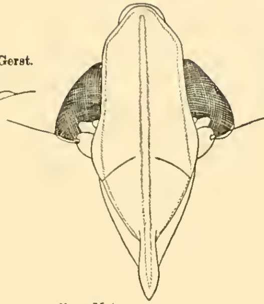
PLATE 9

PLATE 9

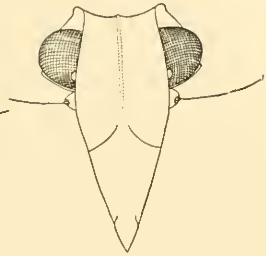
Dorsal, lateral and frontal views of Central American Fulgoridae and Achilidae.



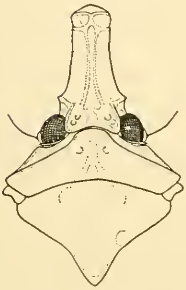
Enchophora prasina Gerst.



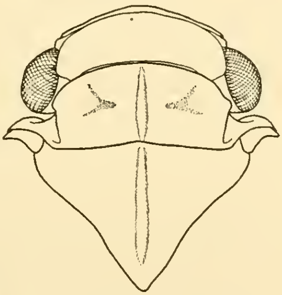
Koloptera callosa Met.



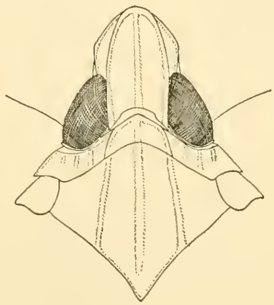
Ateson fuscum Met.



Diareusa conspersa Schmidt

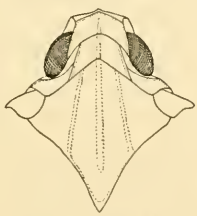


Cyrpoptus obscurus Met.

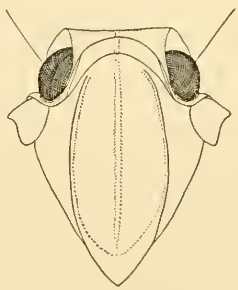


Koloptera callosa Met.

Scaralis neotropicalis Dist.

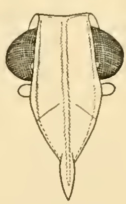


Rhotella punctata Met.



Apateson albomaculatum Fowl.

Scaralis neotropicalis Dist.

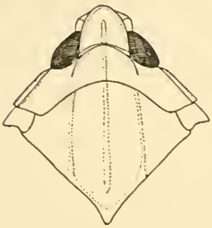


Rhotella punctata Met.

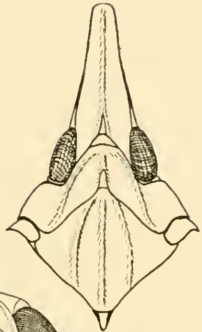
PLATE 10

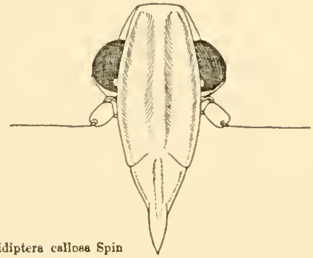
PLATE 10

Dorsal and frontal views of Central American Achilidae and Tropiduchidae



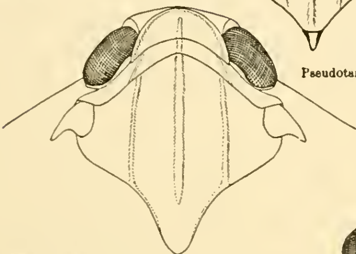
Messoides uniformis Met.



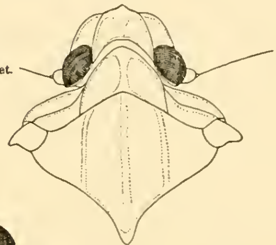


Elidiptera callosa Spin

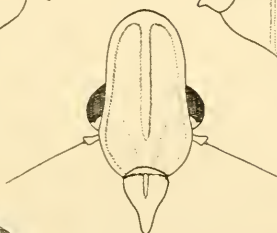
Pseudotangia sponsa Met.



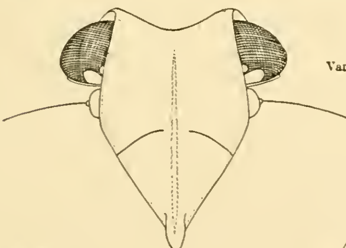
Plectoderes collaris Fab.



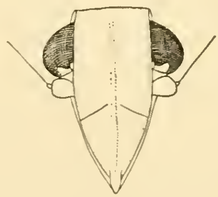
Elidiptera callosa Spin.



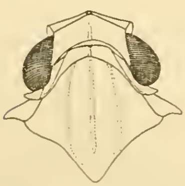
Vanuoides pallescens Met.



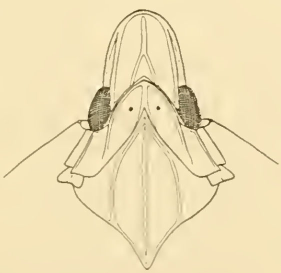
Plectoderes collaris Fab.



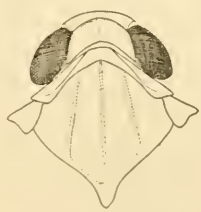
Amblycratus fuscolineatus Fowl.



Amblycratus fuscolineatus Fowl.



Vanuoides pallescens Met.

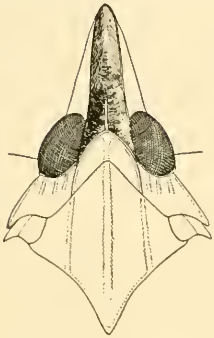


Plectoderes scapularis Met.

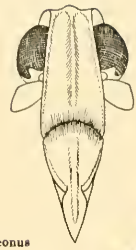
PLATE 11

PLATE 11

Dorsal and frontal views of Central American Achilidae and Nogodinidae.

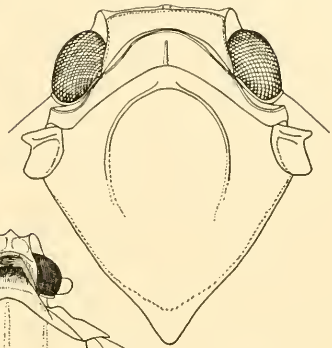


Karpodocephalus lineatus Met.

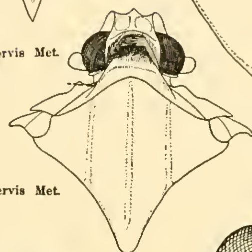


Myconus

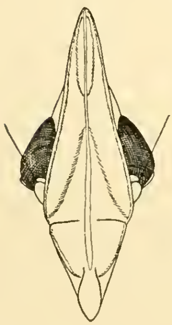
conspersinervis Met.



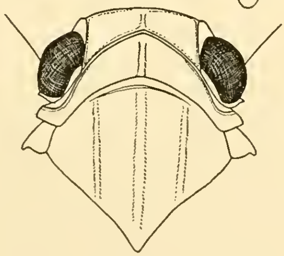
Nogodina reticulata Fab.



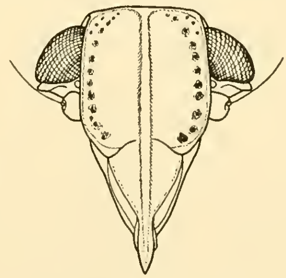
Myconns conspersinervis Met.



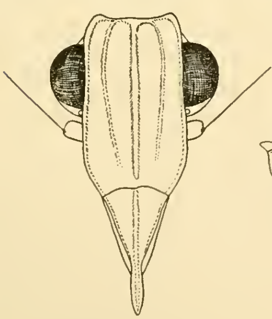
Karpodocephalus lineatus Met.



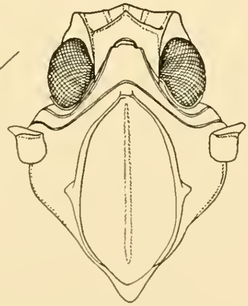
Bladina magnifrons Fowl.



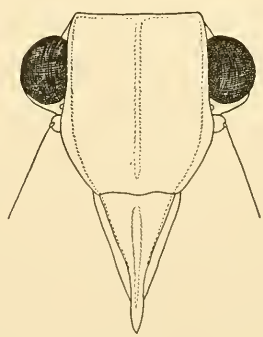
Bladina magnifrons Fowl.



Biolleyana costalis Fowl.



Biolleyana costalis Fowl.

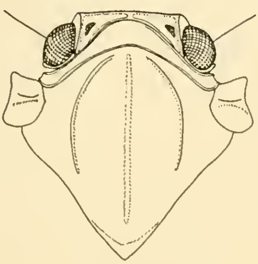


Nogodina reticulata Fab.

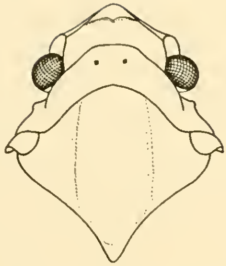
PLATE 12

PLATE **12**

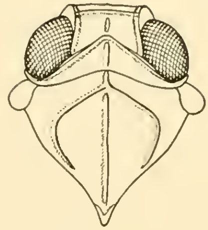
Dorsal and frontal views of Central American Nogodinidae, Flatidae and Issidae.



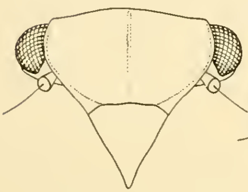
Vutina bipunctata Met.



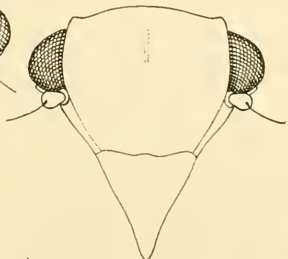
Flatoidinus occidentalis Walk.



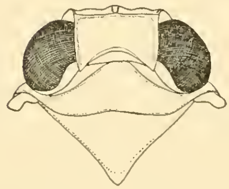
Colpoptera marginalis Burm.



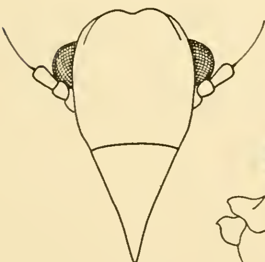
Flatormenis panamensis Schmidt



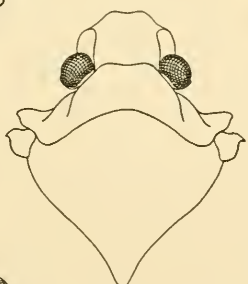
Anormenis discus Walk.



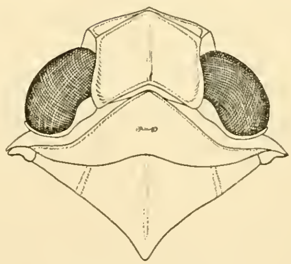
Thionia coriacea Fab.



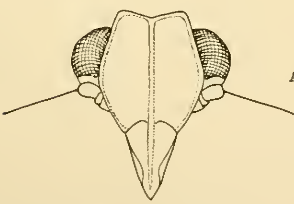
Atracis humeralis Walk.



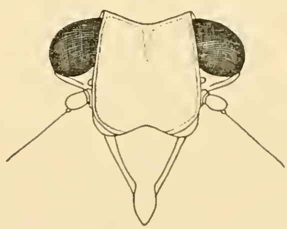
Atracis humeralis Walk.



Thionia transversalis Mel



Colpoptera marginalis Burm.

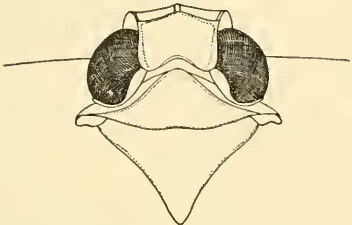


Thionia coriacea Fab.

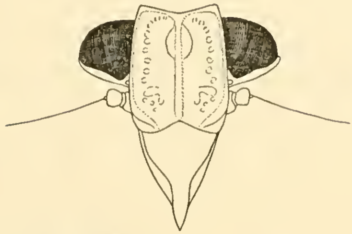
PLATE 13

PLATE **13**

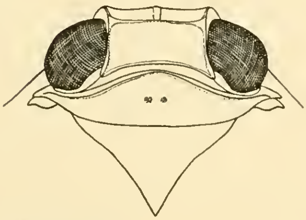
Dorsal, frontal and lateral views of Central American Issidae.



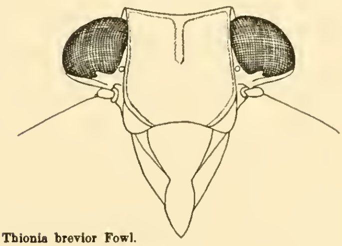
Thionia carinata Mel.



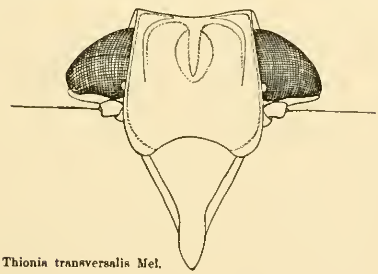
Thionia carinata Mel.



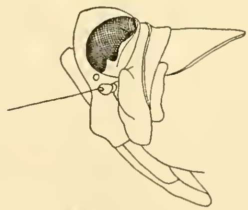
Thionia brevior Fowl.



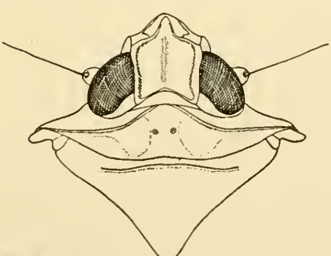
Thionia brevior Fowl.



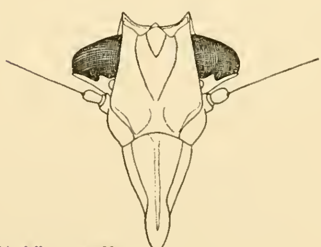
Thionia transversalis Mel.



Thioniella rugosa Met.



Thioniella rugosa Met.

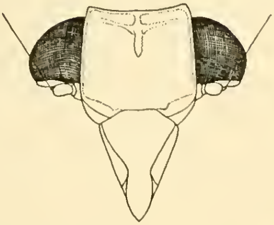


Thioniella rugosa Met.

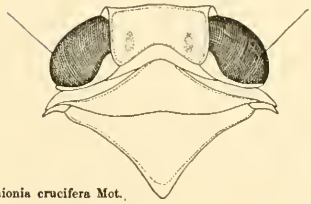
PLATE 14

PLATE 14

Dorsal, frontal and lateral views and wing venation of Central American Issidae and Derbidae.

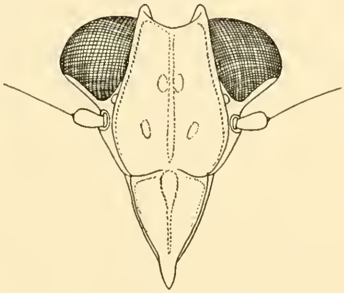


Thionia crucifera Met.

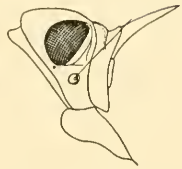


Thionia crucifera Met.

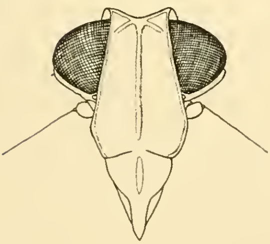
Thionissa acuta Met.



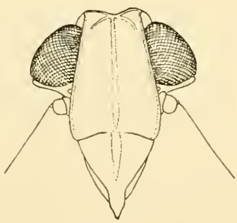
Thioniamorpha marmorata Met.



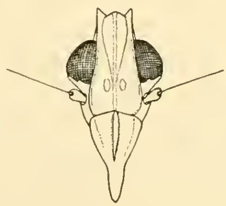
Thionissa acuta Met.



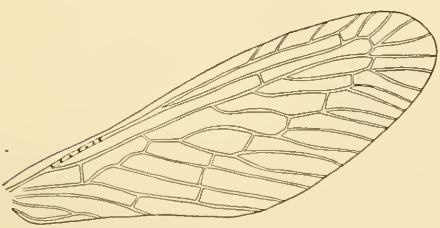
Picumna testacea Met.



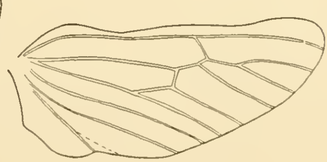
Picumna subrotundata Fowl.



Thionissa acuta Met.



Pseudomysidia fuscovaria Met.



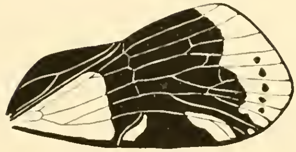
Pseudomysidia fuscovaria Met.

PLATE 15

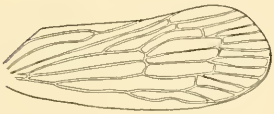
PLATE **15**

Wing venation of Central American Cixiidae, Achilidae, Derbidae and Tropiduchidae.

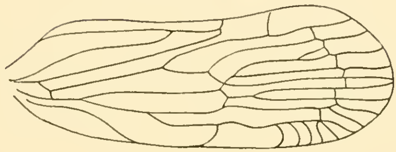
Bothriocera bicornis Fab.



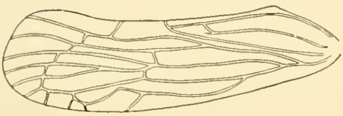
Bothriocera basalis Met.



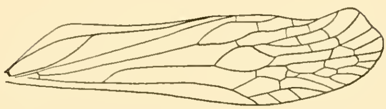
Mnemosyne planiceps Fab.



Atesco marmoratum Met.

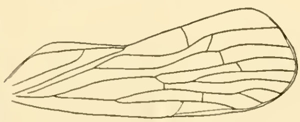


Rhotella punctata Met.

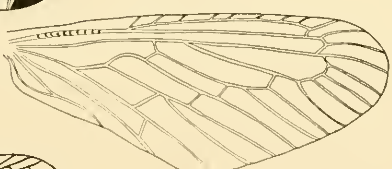


Dictyopharoides tenuirostris Fowl.

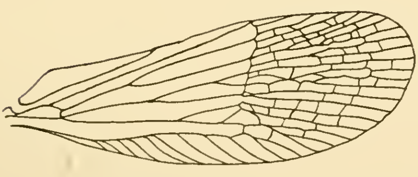
Apateson albomaculatum Fowl.



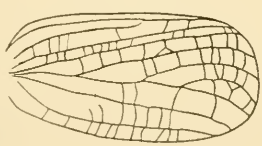
Amblycratus fuscolineatus Fowl.



Mysidis punctifera Met.



Pseudotangia sponsa Met.

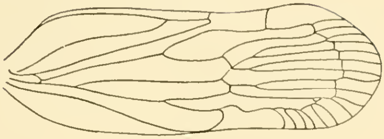


Thionissa acuta Met.

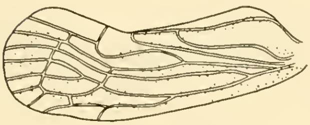
PLATE 16

PLATE 16

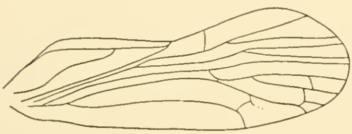
Wing venation of Central American Achilidae, Achilixiidae, Tropiduchidae and Flatidae.



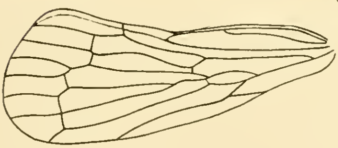
Ateson fuscum Met.



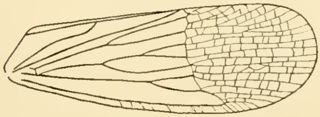
Messeis asper Fowl.



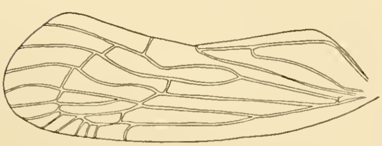
Plectoderes scapularis Met.



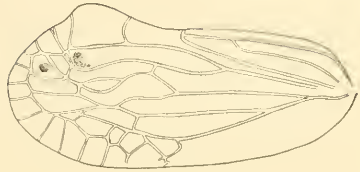
Muirilixius banksi Met.



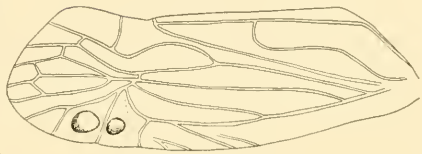
Vanuoides pallescens Met.



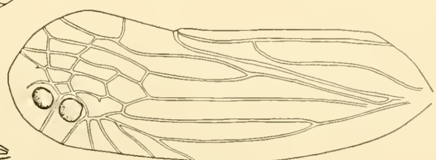
Plectoderes collaris Fab.



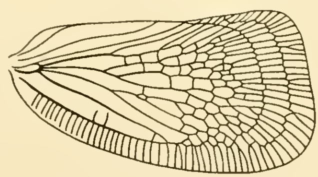
Elidiptera callosa Spin.



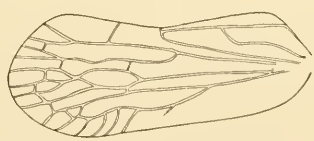
Koloptera callosa Met.



Karpodocephalus lineatus Met.



Anormenis media Mel.



Myconus conspersinervis Met.

PLATE 17

PLATE **17**

External and internal male and female genitalia of Central American Cixiidae and Araeopidae.

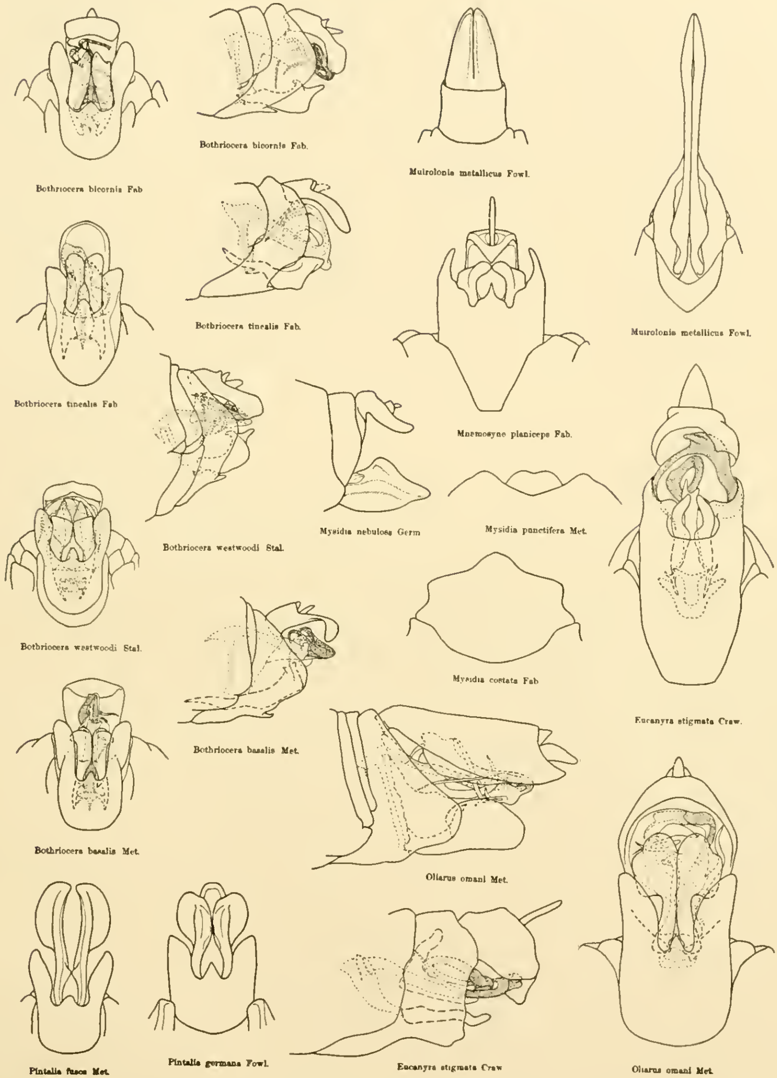

Bothriocera bicornis Fab
Bothriocera bicornis Fab.
Muirolonia metallicus Fowl.
Muirolonia metallicus Fowl.
Bothriocera tinealis Fab
Bothriocera tinealis Fab.
Mnemosyne planiceps Fab.
Bothriocera westwoodi Stal.
Mysidia nebulosa Germ
Mysidia punctifera Met.
Bothriocera westwoodi Stal.
Mysidia costata Fab
Eucanyra stigmata Craw.
Bothriocera basalis Met.
Bothriocera basalis Met.
Oliarus omani Met.
Pintalia fusca Met.
Pintalia germana Fowl.
Eucanyra stigmata Craw
Oliarus omani Met.

PLATE 18

PLATE 18

External male and female genitalia of Central American Derbidae.

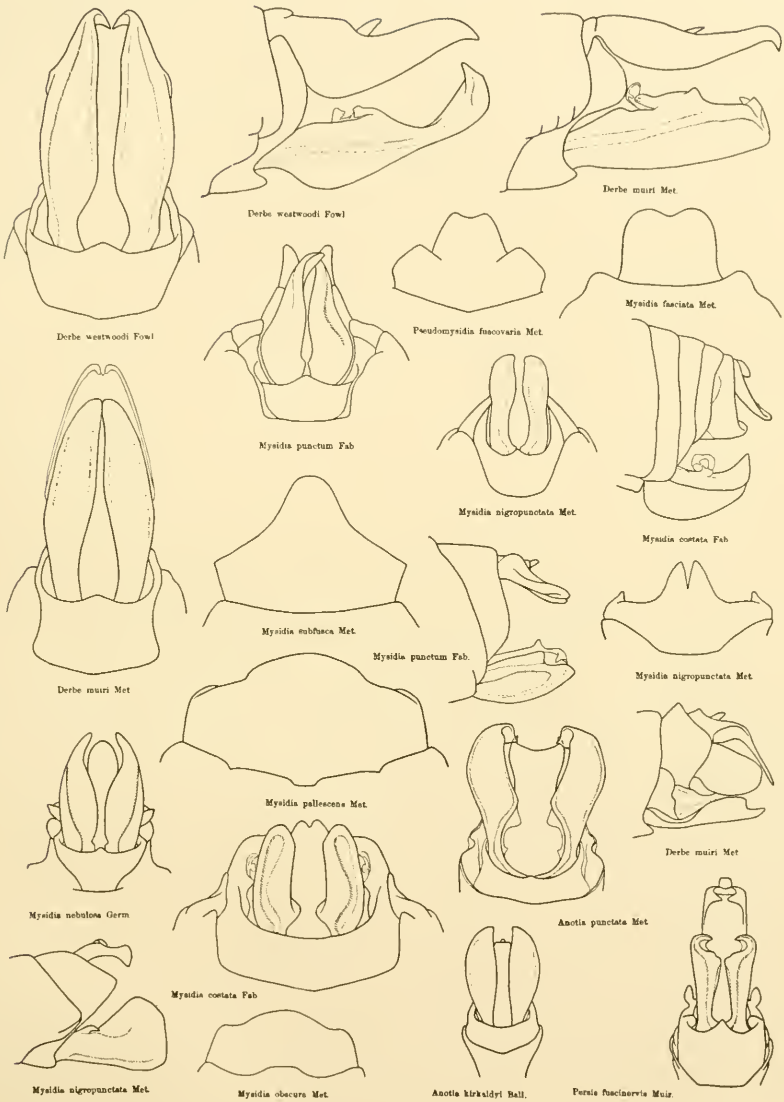
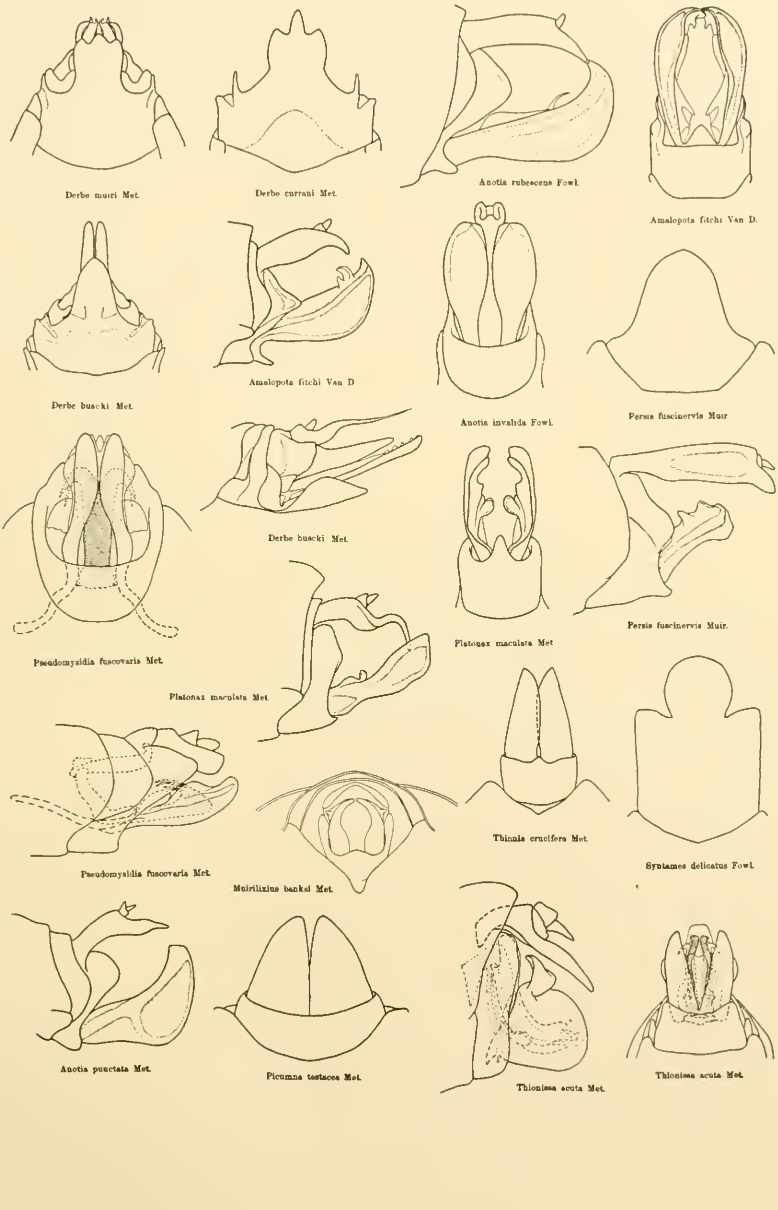

Derbe westwoodi Fowl
Derbe muiri Met.
Derbe westwoodi Fowl
Pseudomysidia fuscovaria Met.
Mysidia fasciata Met.
Mysidia punctum Fab
Mysidia nigropunctata Met.
Mysidia costata Fab
Derbe muiri Met
Mysidia subfusca Met.
Mysidia punctum Fab.
Mysidia nigropunctata Met.
Mysidia pallescens Met.
Derbe muiri Met
Mysidia nebulosa Germ.
Anotia punctata Met.
Mysidia costata Fab
Mysidia nigropunctata Met.
Mysidia obscura Met.
Anotia kirkaldyi Ball.
Persis fuscinervis Muir.

PLATE 19

PLATE 19

External and internal male and female genitalia of Central American Derbidae, Issidae and Achilixiidae.



Derbe muiri Met.

Derbe currani Met.

Anotia rubescens Fowl.

Amalopota fitchi Van D.

Derbe buscki Met.

Amalopota fitchi Van D

Anotia invalida Fowl.

Persis fuscinervis Muir

Derbe buscki Met.

Platonax maculata Met

Persis fuscinervis Muir.

Pseudomysidia fuscovaria Met

Platonax maculata Met.

Thinnia crucifera Met.

Syntames delicatus Fowl.

Pseudomysidia fuscovaria Met.

Muirilixius banksi Met.

Anotia punctata Met.

Picumna testacea Met.

Thionissa acuta Met.

Thionissa acuta Met.

PLATE 20

PLATE 20

External and internal male and female genitalia of Central American Derbidae, Dictyopharidae and Fulgoridae.

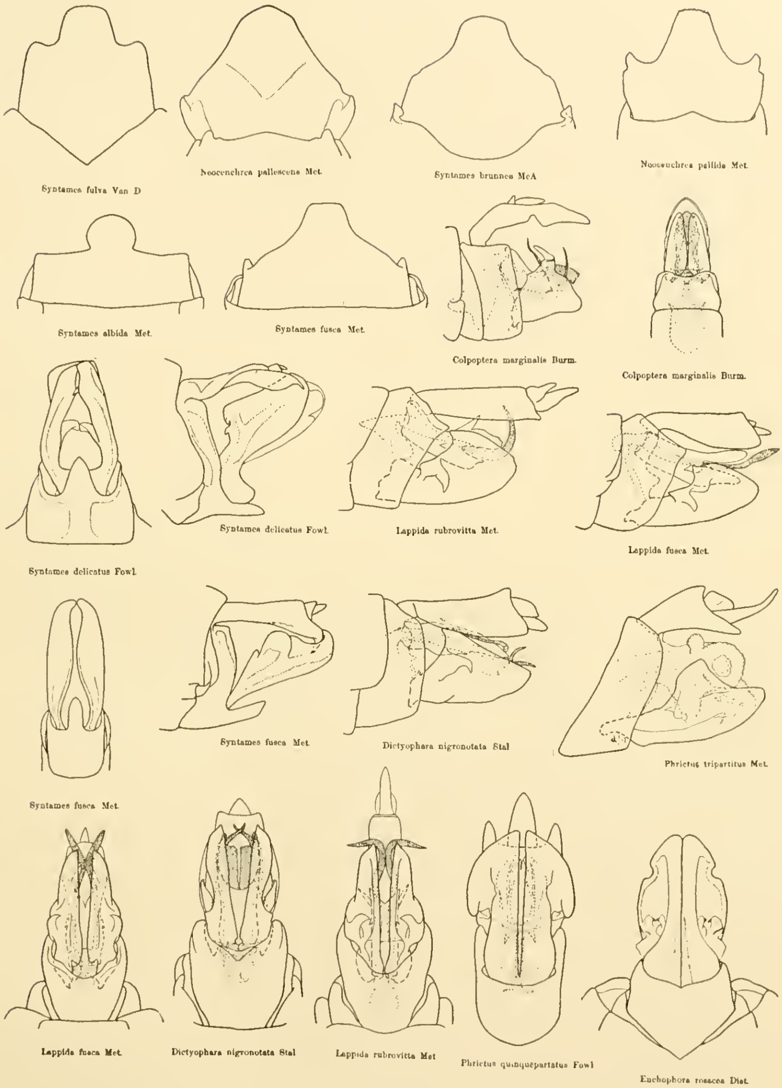
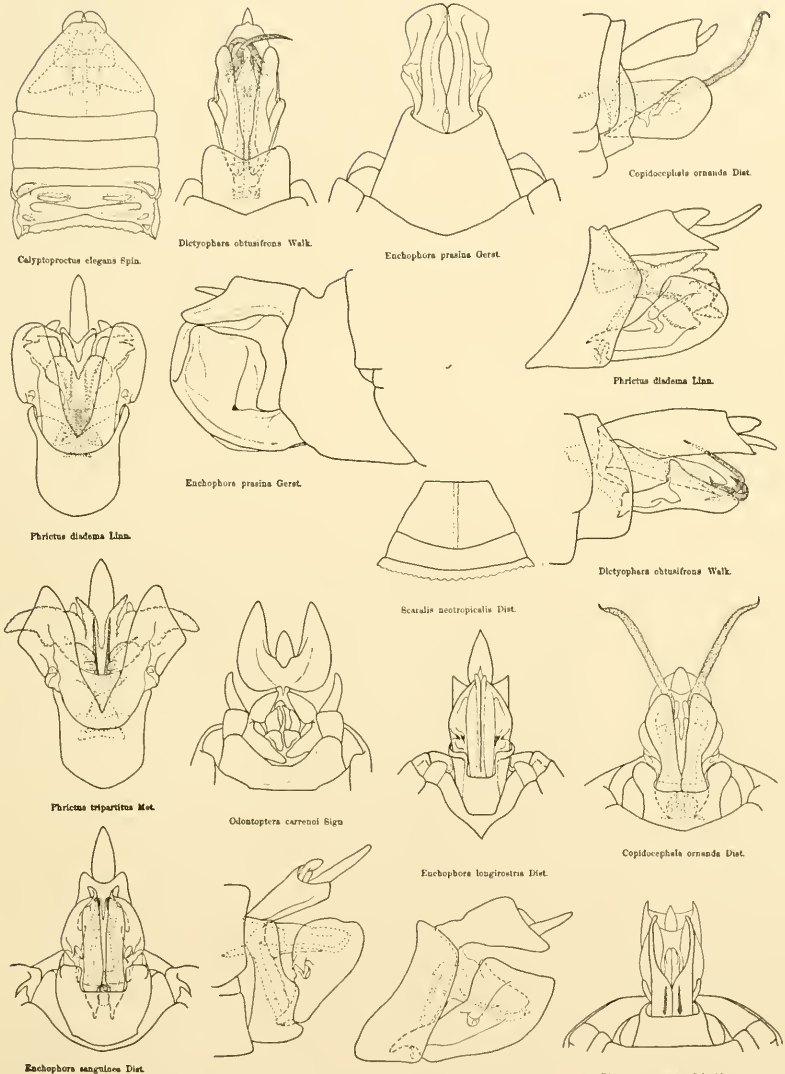

Syntames fulva Van D
Neocenchrea pallescens Met.
Syntames brunnea McA
Neocenchrea pallida Met.
Syntames albida Met.
Syntames fusca Met.
Colpoptera marginalis Burm.
Colpoptera marginalis Burm.
Syntames delicatus Fowl.
Syntames delicatus Fowl.
Lappida rubrovitta Met.
Lappida fusca Met.
Syntames fusca Met.
Syntames fusca Met.
Dictyophara nigronotata Stal
Phrictus tripartitus Met.
Lappida fusca Met.
Dictyophara nigronotata Stal
Lappida rubrovitta Met
Phrictus quinquepartatus Fowl
Enchophora rosacea Dist.

PLATE 21

PLATE **21**

External and internal male and female genitalia of Central American Fulgoridae.



Calyptoproctus elegans Spin.

Dictyophara obtusifrons Walk.

Enchophora prasina Gerst.

Copidocephala ornanda Dist.

Phrictus diadema Linn.

Enchophora prasina Gerst.

Phrictus diadema Linn.

Dictyophara obtusifrons Walk.

Scaralis neotropicalis Dist.

Phrictus tripartitus Met.

Odontoptera carrenoi Sign

Enchophora longirostris Dist.

Copidocephala ornanda Dist.

Enchophora sanguinea Dist.

Enchophora sanguinea Dist.

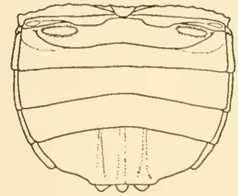
Phrictus quinquepartatus Fowl.

Diareusa consperas Schmidt

PLATE 22

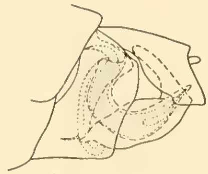
PLATE **22**

External and internal male and female genitalia of Central American Fulgoridae, Nogodinidae, Achilidae and Flatidae.



Alphina glauca Met.

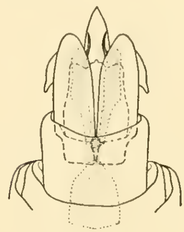
Plectoderes scapularis Met.



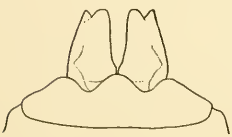
Biolleyana costalis Fowl.

Amblycratus fuscus Met.

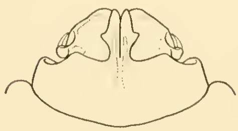
Ateson fuscum Met.



Bladina magnifrons Fowl.

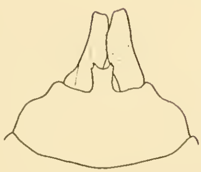


Ateson marmoratum Met.

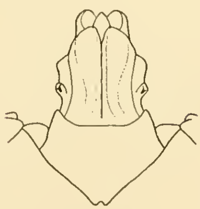


Messeis asper Fowl.

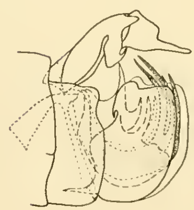
Amblycratus fuscolineatus Fowl.



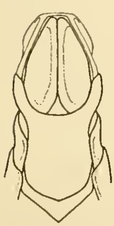
Karpodocephalus lineatus Met.



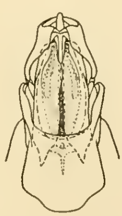
Cyrpoptus obscurus Met.



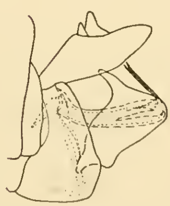
Bladina magnifrons Fowl.



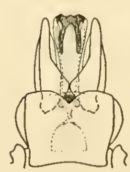
Nogodina reticulata Fab.



Biolleyana costalis Fowl.



Poekilloptera phalaenoides Linn.

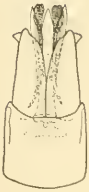


Poekilloptera phalaenoides Linn.

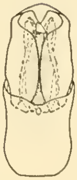
PLATE 23

PLATE 23

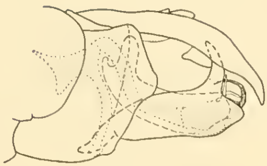
External and internal male and female genitalia of Central American Flatidae and Cixiidae.



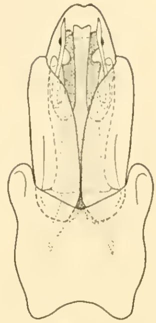
Ormenia roscida Germ



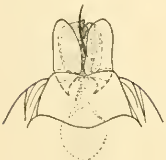
Atracis humeralis Walk.



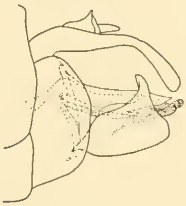
Flatoidinus occidentalis Walk



Flataloides obliqua Walk



Anormenia media Mel.



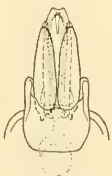
Ormenia roscida Germ.

Anormenia media Mel.

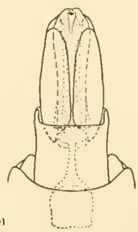
Flatormenis albescens Fowl.

Flatormenis griseoalba Fowl

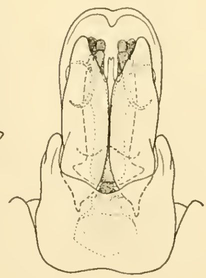
Pintalia erecta Met.



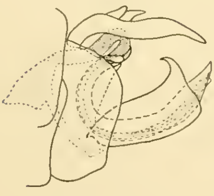
Flatormenis griseoalba Fowl



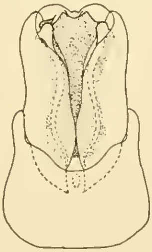
Flatormenis panamensis Schmidt



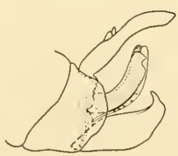
Flatoidinus occidentalis Walk.



Flatormenis panamensis Schmidt



Atracis pollutus Fowl.



Atracis humeralis Walk.

Pintalia erecta Met.

Flataloides obliqua Walk

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NEW AND NOTEWORTHY MILLIPEDS FROM CUBA, COLLECTED BY DR. P. J. DARLINGTON IN 1936

By H. F. Loomis

Bureau of Plant Industry
U. S. Department of Agriculture

CAMBRIDGE, MASS., U. S. A.

PRINTED FOR THE MUSEUM

October, 1938

No. 6. — *New and Noteworthy Millipeds from Cuba Collected by Dr. P. J. Darlington in 1936*

By H. F. Loomis

The island of Cuba is richly endowed with species of millipeds, a statement which seems distinctly paradoxical in view of the fact that until now only slightly over fifty species have been reported from there. Nevertheless, conditions are recognized which clearly indicate that a great many millipeds await discovery, probably more than have been reported in the past, coupled with those described in this paper. The few collections that have been made in Cuba contained such a large proportion of new material that it is evident they represented but small fragments of the complete fauna. Furthermore, intensive search has been made only in Oriente Province, at the east end of the island, and even that has not been thoroughly explored, but the number of species already found there may to some extent be considered indicative of what exists in the other provinces. While wide distribution of certain species occurs, the rule in tropical countries is that the majority of species are quite localized, so that the millipeds of one region may be expected to differ considerably from those elsewhere. Another reason for believing that many undiscovered species remain in Cuba is that very few tiny forms have been reported, and Cuba probably is no exception to the other West Indian Islands in its possession of numerous small kinds of millipeds.

Our knowledge of the Cuban millipeds comes from a few collections of one or more species, only a half dozen collections having exceeded four species and but two of these exceeded eight species. A collection made by C. T. Ramsden in 1913 and 1914 in Oriente Province contained 23 species, all of which were described as new by R. V. Chamberlin.[1] The largest collection, however, was made by Dr. P. J. Darlington, of the Museum of Comparative Zoology, Cambridge, Mass., in the summer of 1936, and contained 31 species. This collection forms the basis of the present paper. The 31 species were gathered in three provinces; 1 from Pinar del Rio; 4 from Santa Clara; and 26 from Oriente, many coming from the upper slopes of Pico Turquino, the highest mountain in Cuba and a totally new locality for milliped collecting. In this collection three species from Oriente and one from Santa Clara Provinces are represented only by females and are unassignable to named forms, five of the species were previously de-

[1]Bull. Mus. Comp. Zool., **62**, no. 5, p. 171–250, 1918; Proc. U. S. Nat. Mus., **61**, art. 10; p. 1–19, 1922.

scribed, and 22 are described as new, bringing above 75 the number of species known to inhabit Cuba. With the material in the Darlington collection the number of species now credited to each of the provinces is as follows: Oriente, 49 species; Santa Clara, 12 species; Camaguey, 6 species; Pinar del Rio, 5 species; Habana and Matanzas, 2 species each; Isle of Pines, whose fauna appears to be an integral part of that of Cuba, 5 species and 1 variety; and in addition 8 species have been reported without definite locality. In this list several species are common to two or more provinces, as *Orthomorpha coarctata,* the only introduced species, which has been recorded from five provinces.

Remarkable in the Darlington collection are the many species of *Rhinocricus* contained, not one of which appears to have been described before. Three noteworthy new genera of the order Merocheta were included; one having the longest dorsal hairs of any known milliped; another with repugnatorial pores in a position not previously observed in its family; and the third genus has almost no lateral carinae and is the first indigenous member of the family Strongylosomidae to be found in Cuba.

The types, paratypes, and all other specimens gathered by Dr. Darlington are in the Museum of Comparative Zoology.

Family STEMMIULIDAE

Prostemmiulus robustus Chamberlin

Bull. Mus. Comp. Zool., **62**, no. 5, p. 177, 1918.

One female from about 1000 feet elevation, Rio Frio, Boniato Range, Oriente Province, June 5, 1936.

Answering the original description and exhibiting the following additional characters.

Length near 30 mm; number of segments 46. Antennae with inner joints dark but beyond the middle of joint 5 the color is light; the antennae shorter than in the related *P. tenebrosus,* joints 3 to 5 subequal in length, exceeded by joint 2, which is about once and a half as long as joint 6. Mandible with the stipe rounded-acute at its lower end, not squarely truncate as in *P. tenebrosus.* Segment 3 with the excavation of the ventral posterior margin long but shallow, the pleural element mesad of it triangular in shape. Median furrow of the segments strongly impressed. Striae first attaining the middle of the dorsum on segment 13 or 14. Preanal scale of the same general shape as in *P. tenebrosus* but not as long in proportion to the width.

PROSTEMMIULUS TENEBROSUS new species

Collected on Pico Turquino, Oriente Province, one female (type) above 5000 feet elevation, June 16–21, 1936, and two females from Cueva del Aura, 1500–3800 feet elevation, June 11, 1936.

Diagnosis. The large size; numerous segments, all but the first and last of which are dark colored; subequal ocelli; and the shape of the mandibulary stipe and preanal scale distinguish this species. The closely related *P. robustus* Chamb. has the head and first four segments light colored and the mandibulary stipe rounded-angular, instead of truncate, at its anterior limit.

Description. Body stout and laterally compressed, the type specimen largest, 36 mm long, 3.2 mm wide, 3.5 mm high; scarcely constricted at segments 3, 4, and 5, the posterior end of the body narrowing gradually; number of segments 46 to 49.

Color in alcohol, head and first segment light red; ensuing segments to the penultimate with the posterior fourth translucent golden brown, the dorsum in front of it solidly dark, almost black, very faintly diluted along the median line but without a definite fascia; sides dark with a maculate area including the pore in its upper portion, this area usually joined to another area further ventro-cephalad by a maculate band; near the legs the color gradually changes from blackish to brown; last segment colorless on dorsum and along entire posterior margin, the sides elsewhere dark; anal valves with dark inner surface surrounded by a light border; preanal scale colorless; two outer joints of antennae colorless, inner joints dark.

Head and first segment as shown in figure 1a. Antennae long and slender, the second joint much exceeding the others in length, the sixth joint only half as long; fifth joint strongly clavate, exceeding the others in width at its distal end. Ocelli large, the lower one nearly as large as the upper one, never more than a fourth smaller. Stipe of mandible broadly and squarely truncate at its lower end.

First segment with a long stria extending downward along the front margin from above the upper ocellus, a shorter stria in front of it beginning much lower down; in front of this shorter stria and on the ventral surface, hidden in lateral view, are two other fine short striae.

Third segment with the ventral posterior margin deeply and extensively excised, leaving a slender, lobe-like pleural element adjacent to the legs.

Striae of the second segment confined to the area immediately following the posterior ends of the striae on segment 1; on the following

segments they gradually ascend, reaching the dorsum on segment 7 or 8 but not its middle until segment 10; median sulcus of segments strongly impressed, the incision at its posterior end short and narrow.

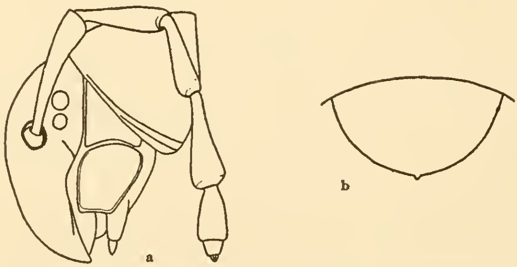

Fig. 1. *Prostemmiulus tenebrosus.* *a*, Head and first segment of type, lateral view; *b*, Preanal scale of type.

Last segment with dorsum as long as the penultimate segment.
Anal valves scarcely inflated, with thin raised margins.
Preanal scale large, the shape as shown in figure 1b.

Prostemmiulus baliolus new species

One male (type) and one female from between 3000 and 4000 feet elevation, mountains north of Imias, Oriente Province, July 25, 1936.

Diagnosis. Closely related to *P. cubae* Chamb., but larger and with the head and anterior segments darker; the first segment with three striae instead of one as in *P. cubae.*

Description. Female about 28 mm long and 2 mm wide, 48 segments; the male a little shorter and more slender in proportion, 44 segments. Body generally dark brown or blackish above, beginning with the head and continuous to the last segment; the posterior fourth of the segments translucent amber through which a light spot is distinguishable at the middle of the dorsum on the succeeding segment, surface between the spot and the posterior margin slightly lighter than the outer dorsal surface but not forming a distinct median light line or fascia; pore surrounded by a maculate area; ventral surface light; antennae with the five basal joints dark, the outer ones light; preanal scale and anal valves, except their raised margins, dark.

Head lacking an impressed median sulcus on the vertex. Ocelli con-

tiguous, the upper one double the size of the lower. Antennae long and slender; joint 2 longest, the next three shorter, subequal; joint 6 half as long as the second. Mandibulary stipes of the male rather narrow and obliquely truncated, the surface strongly inflated longitudinally with the lower margining rim greatly raised; female with stipes larger, broader, less obliquely truncated and with the lower rim less elevated, but with a distinct tooth projecting forward from the lower anterior corner.

Fig. 2. *Prostemmiulus baliolus*. *a*, Gonopods, anterior view; *b*, Gonopods, posterior view.

First segment with three striae visible in lateral view; the posterior longest, beginning above the upper ocellus, the middle stria beginning behind it; the first stria very short, at the lower corner; ventral surface sharply turned under.

Segment 4 of the male with the pleurae produced inward, forward and downward into a long, slender, acute lobe between the first and third legs and just ectad of the second legs; pleurae of the third segment not specially produced or elevated. In the female the posterior ventral margin of the third segment is deeply excavated for a short distance; the inner, pleural element projecting as a short lobe, rounded behind. Striae attaining the mid-dorsal region on segment 11. Median sulcus of segments fine and very lightly impressed. Aside from the oblique striae the segments of the male are almost smooth but in the female short longitudinal aciculations are evident, especially just in advance of the posterior margin.

Anal valves not inflated, flattened transversely, margins only slightly

raised. Preanal scale shaped as in *P. tenebrosus,* rounded behind, with a tiny apical tubercle.

Gonopods as shown in figure 2*a* and *b*.

First legs of male enlarged, heavier than the other pregenital legs, with many short clavate hairs. Second legs small, (not dissected), the outer one or two joints bent sharply forward, clawless; ensuing legs normal.

PROSTEMMIULUS STRIGATUS new species

One male from Sierra de Cobre, Oriente Province, 3000 to 3800 feet elevation, July 3–7, 1936.

Diagnosis. Much larger than *P. nesides* Chamb., based on a female from the Isle of Pines, but with quite similar coloration; the ocelli do not differ in size so greatly; the first segment has three striae, of which the posterior is unusually impressed.

Description. Length 27 mm, width 2.2 mm; body strongly compressed laterally, widest at the second and third segments, constricted at the fifth segment, posterior end of body narrowing rather gradually; number of segments 45.

Head and first four segments white except that the cardo and stipe of the mandibles and joints 2, 3 and 4 of the antennae are dark; on the ensuing segments the anterior subdivision has a large white spot at middle covered by the preceding segment, laterad the surface is dark with light maculations to the middle of the side, below which it is white; posterior subsegments with the caudal third translucent amber, the anterior two thirds black above, without a light median line on the anterior segments but behind the middle of the body a very narrow, somewhat broken line becomes apparent and is continuous on the last segments; pore in a small white spot instead of the usual large maculate area but below the pore the surface is dark-maculate to the base of the legs; preanal scale and all of the valves, except the raised margins, dark.

Head with a long, fine sulcus on the vertex; ocelli subequal, the lower one almost as large as the upper one; antennae long and very slender, joint 2 considerably longer than the three subequal joints which follow, and twice as long as joint 6; mandibulary stipe long, narrow, the lower rim greatly raised as in *P. baliolus* but the anterior end more obliquely truncate, almost continuous with the lower side.

First segment with three lateral striae, the anterior very short; the middle one long, reaching opposite the upper ocellus; the posterior reaching well above it and much more strongly impressed than in the

other species, the surface between it and the middle stria conspicuously raised, almost ridge-like.

Second segment with striate area larger than in the other species, the striae extending much above the posterior ends of those of segment 1. Pleura of segment 3 raised into a small angular lobe. Pleura of segment 4 continued inward, slightly forward, and raised into a long,

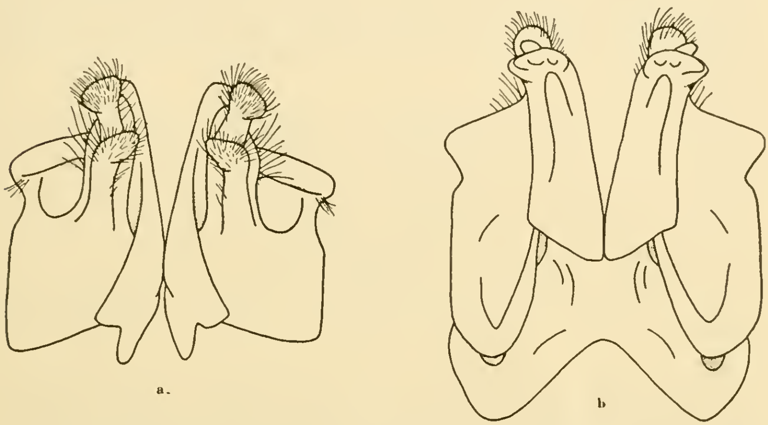

Fig. 3. *Prostemmiulus strigatus.* *a*, Gonopods, anterior view; *b*, Gonopods, posterior view.

acute lobe. Striae reaching mid-dorsal region on segment 11. Median sulcus of segments strongly impressed, the notch at its posterior end very short and narrow, scarcely evident.

Anal valves not inflated, the raised margins thin. Preanal scale shaped as in *P. tenebrosus*.

Gonopods as shown in figure 3*a* and *b*.

Anterior male legs as in *P. baliolus*.

Prostemmiulus spp.

Females of two species impossible to identify with certainty were included in the collection; one female came from between 3000 and 3800 feet elevation, Sierra de Cobre, Oriente Province, July 3–7, 1936; two females from between 1000 and 1800 feet elevation, Yunque de Baracoa, Oriente Province, July 13, 1936.

Family EPINANNOLENIDAE

Epinannolene biseriatus new species

Male type and two small females from between 2000 and 5000 feet elevation on south side of Pico Turquino, Oriente Province, June, 1936; a large female from between 5000 feet and the summit of the same mountain, June 16–21, 1936; two males from between 3000 and 4000 feet elevation, mountains north of Imias, Oriente Province, July 25, 1936.

Diagnosis. Very closely related to *E. bicornis* Brole. and *E. pittieri* Brole. from Costa Rica and Cocos Island respectively, as shown by the gonopods but otherwise distinguished by having ocelli in two or very rarely three series, the third series being represented by only one or two ocelli. It is much smaller than *E. bicornis* and has only one large stria on the side of segment 1, whereas *E. pittieri* has two.

Description. The largest specimen, a female, is 22 mm long and 1.2 mm in diameter; number of segments 51 to 54. Body constricted behind the first segment to segment 5 after which it broadens somewhat.

First segment surrounded by a narrow colorless margin bordered within by a solid dark band, inside of which the surface is dark brown, areolate with tiny light spots. Ensuing segments with anterior division light in front, dark brown behind except for a small area maculate with light spots high on each side near the constriction; posterior subsegment with anterior two-thirds dark brown with an elongate maculate area above and in front of the pore extending forward and upward nearly joining the area on the anterior subsegment, posterior third colorless, translucent; anal valves, legs and antennae light brown. In young specimens the color is not as dark but a dark stripe along the sides of the body at the line of the pores is conspicuous.

Head with clypeal setae 3–3, labral setae 6–6 to 8–8. Ocelli generally in two variable series as 4, 7; 5, 6; 5, 7; 6, 8; but sometimes three series as 2, 6, 8; while one male has 1, 5, 8 on one side of the head and 5, 6 on the other side. Antennae short and quite stout, joint 6 broadest and as long or a little longer than any other joint, succeeded in order of length by joints 2, 3, 5, 4, 1. Mandibulary stipe of male broad, with a raised rim on the sides and in front; anterior margin squarely truncate; stipe of the female much narrower, the anterior margin shorter and more rounded.

First segment evenly but rather narrowly rounded on each side,

with a margining rim extending downward from behind the eye around to the posterior margin; removed well above the lateral margin is a deep stria extending caudad and slightly ventrad from behind the eye to the posterior margin, a fine, short stria may be found on either or both sides of the larger one but not reaching either the front or back margin.

Succeeding segments with a pronounced median constriction containing a sharply impressed sulcus lacking dorsal pits, the surface in front of the constriction moderately convex, that behind it strongly

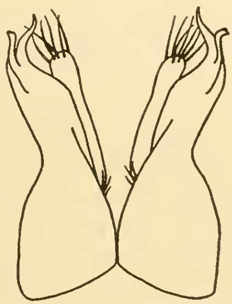

Fig. 4. *Epinannolene biseriatus.* Gonopods of type, anterior view.

convex; surface on either side brilliantly shining but high magnification shows very fine reticulations; lateral striae beginning in front of the constriction as deeply impressed semi-circles, open caudally, with the lower end continued across the constriction and the metazonite of segment 2 to segment 8 or 9, behind which the crescentic impressions are not followed by striae but are restricted to the prozonite; on none of the segments do the striae of the prozonite or metazonite reach the level of the pores. Pores beginning on segment 5.

Last segment with a definitely produced, broadly rounded apex which does not project beyond the convex, strongly shining anal valves; preanal scale subelliptic, the back margin almost as fully rounded as the front one, lateral processes of moderate size.

Gonopods as shown in figure 4.

Free ventral border of the seventh segment of the male raised on each side into a high auriculate lobe quite like that in *E. pittieri.*

Family SPIROBOLIDAE

Rhinocricus Karsch

Syn. *Cubobolus* Chamberlin.

The genus *Cubobolus* was proposed for a Cuban milliped[1] characterized by its lack both of scobinae and raised margins on the anal valves, but having four antennal cones, and gonopods of a form considered of generic importance. Several years later Chamberlin remarked that it might be necessary some day to withdraw this genus into *Rhinocricus*.[2] With the present study the group of West Indian Rhinocricus-like millipeds which lack scobinae numbers ten species. Included therein are species which have numerous antennal cones, others with raised margins on the anal valves, and the gonopods conform in few particulars with those of *C. beliganus,* and these particulars are not confined to the non-scobinate species alone. Also examination of the female paratype of *C. beliganus*, M.C.Z. no. 4419, revealed that the anal valves have narrow but distinctly raised margins with the margin set off from the adjoining surface by a definite stria. Hence it appears that in the case of the West Indian rhinocrids the presence or lack of scobinae is a specific character and the genus *Cubobolus* must stand as a synonym of *Rhinocricus*.

Rhinocricus etymophallus new species

One male (type) and two females from Rio Frio, Boniato Range, Oriente Province, at about 1000 feet elevation, June 5, 1936.

Diagnosis. Among the West Indian rhinocricids the only species which have the median plate of the gonopods constructed as in the present species are found in the genus *Nesobolus* Chamberlin, but the form of the anterior lobes and the inner gonopods of this animal are not as in that genus and the species is placed in *Rhinocricus,* where the median plate and inner gonopods distinguish it. This species and *R. sagittatus* are the only members of the order Anocheta known to me to have a distinct and protrusible penis immediately behind the second legs, which, however, does not indicate close affinity of the two species.

Description. Males more slender than females, 34 mm long, 2.8 mm wide; female 28 mm long, 3.5 mm wide; number of segments 47 to 50. Body of alcoholic specimens with alternating bands of yellowish white

[1] *C. beliganus* Chamberlin, Bull. Mus. Comp. Zool., **62**, p. 206, 1918.
[2] Proc. U. S. Nat. Mus., **61**, art. 10, p. 10, 1922.

and dark brown, the light bands broadest below, the dark ones broadest dorsally; fore-belt entirely light colored; mid-belt solidly dark on dorsum, maculate with light spots below the pores; hind-belt with anterior two-thirds dark above pores, posterior third and entire surface below pores light colored; last segment dark except at apex; anal valves light with a dark median spot on each; preanal scale with dark median spot.

Head not sulcate at middle of vertex but finely so on the front below the antennae to the clypeal margin. Ocelli convex, distinct, in

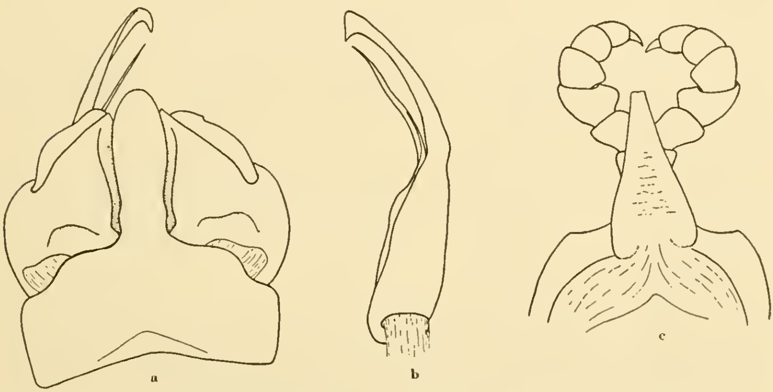

Fig. 5. *Rhinocricus etymophallus.* *a*, Gonopods, anterior view; *b*, Inner gonopod; *c*, Second legs and extruded penis of male, posterior view; the tip of the penis appears to have been broken off.

five series, counting forward from margin of first segment — 6, 6, 6, 5, 3, forming a rounded-triangular cluster. Antennae quite slender, joints 2 and 6 subequal in length, longer than joints 3, 4, and 5, which resemble each other in length; all six inner joints of about the same diameter; sense cones four.

First segment with sides evenly rounded throughout, a raised rim only along the anterior curve, below the eye; surface smooth and shining.

Second segment with scarcely any shoulder below the limits of the first segment.

From segment 2 to within five or six segments of the posterior end of the body each segment is encircled by a strongly impressed sulcus between mid- and hind-belt, passing with usually a short, abrupt curve

just behind the pore; lateral sutures not impressed; ventral striae equalling or slightly exceeding the tips of the legs, which are large and reach the sides of the body; fore-belt dull and very finely reticulated but without annular striae; mid- and hind-belt smooth and shining; scobinae present and extending to segment 19 or 20.

Last segment broadly produced into an obtuse but abruptly angular apex depressed below the level of the surface in front of it. Anal valves moderately convex, with margins not raised, meeting in a groove; sides smooth but gradually becoming distinctly rugose towards the margins with the rugae parallel. Preanal scale large, triangular.

Gonopods as shown in figure 5*a*, the median surface of each anterior lobe raised high above the surface of the distal lobe of the median plate; inner gonopod shown in figure 5*b*, the slender ventral arm or division apparently distinct from the upper division for the full length of the gonopod although its basal half is very closely applied to the much larger upper division.

Second male legs followed by a thin, long, narrowly triangular penis projecting from the body and surpassing the second joint of the legs (Fig. 5*c*); the organ undoubtedly retractible into the body as in *R. sagittatus*.

Coxae of male legs 3 to 6 continued into erect, subconic lobes, those of the third legs largest and thickest, the others decreasing in size with those of the fifth legs the thinnest; coxae of seventh legs somewhat like those of *R. sagittatus* but smaller; outer joints of legs 3 to 7 with concentricly striate lobes much like those of *R. sagittatus*.

Ventral crest of the seventh male segment greatly raised on each side of the middle, forming two high, backwardly rolled lobes separated by a deep narrow median sinus; ventral anterior margin of segment deeply and evenly concave without an additional excision at middle for the tips of the gonopods.

Rhinocricus gonolepis new species

One male collected between 3000 and 4000 feet elevation in the mountains north of Imias, Oriente Province, July 25–28, 1936.

Diagnosis. From the structure of the median plate and anterior lobes of the gonopods, and the modifications of the anterior male legs, it is evident that this species connects *R. clypeatus* and *R. sagittatus* with the group of medium sized species having the apical half of the median plate of the gonopods suddenly reduced to less than half the width of the basal portion.

Description. Length 40 mm, width 3.5 mm; number of segments 57. Color in alcohol brown, the mid-belt darker than the fore-belt or hind-belt, the posterior fourth of the latter colorless and nearly transparent.

Head with vertex medianly impressed for a very short distance; the front with a longer and more pronounced median sulcus; surface elsewhere shining but very finely rugulose. Eyes nearly circular, composed of distinctly convex ocelli in series, 6, 6, 6, 6, 3, 2, counting forward from along the margin of the first segment. Antennae rather slender, joint 2 definitely longer and somewhat broader than any other; joint 6 next longest; joints 1, 3, 4, and 5 subequal in length; sense cones four.

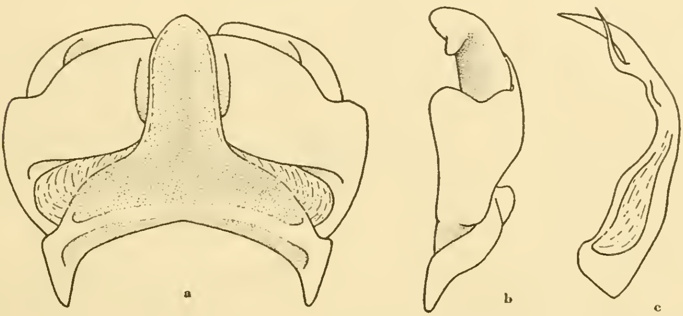

Fig. 6. *Rhinocricus gonolepis.* *a*, Gonopods, anterior view; *b*, Lateral view of gonopods, showing the thickened anterior lobe; *c*, Inner gonopod.

First segment broadly rounded on the sides, the raised rim extending from behind the eye a little beyond the lower limit of the side; surface rather finely rugulose but shining.

Second segment without a prominent shoulder or hump below the first segment.

All segments, except the first and the last three, encircled by a strongly impressed sulcus between mid- and hind-belt, the sulcus scarcely bent in passing behind the pore which is in contact with it; no lateral sulci; ventral striae fine, restricted, not extending beyond the tips of the legs. Fore-belt encircled by very fine, inconspicuous striations; mid-belt and anterior half of hind-belt rugulose, especially on the anterior segments, on the posterior segments only finely aciculate; posterior half of hind-belt smooth and shining. Scobinae deep, crescentic, followed by the usual striate area; number of scobinate segments not ascertained.

Last segment with a short, rounded apex exceeded by the anal valves; surface more rugulose than the anterior segments. Anal valves uniformly convex, forming an almost perfect hemisphere; margins raised into very fine rims meeting at the level of the valves, not in a groove; surface with short striations paralleling the margin, rugose farther away. Preanal scale with apex broadly truncated, even a little emarginate; surface longitudinally finely striate, especially along the posterior margin.

Gonopods with median plate much depressed, the basal half with a ridge extending inward from each side almost to the middle (Fig. 6*a*); anterior lobes with outer side greatly thickened (Fig. 6*b*); inner gonopod as shown in figure 6*c*.

Male with anterior coxae modified much as in *R. sagittatus*, the lobes of the third and fourth coxae as long or longer but the tips not turned outward; fifth and sixth coxae very broad, as in that species, but lacking a lobe at the outer posterior corner, and the sixth coxae much thicker; seventh coxae almost perfect cubes, longer than thick, the median surface of the exposed face depressed; other joints of the anterior legs stout but without concentricly striate ventral lobes as in *R. sagittatus*.

Seventh male segment with ventral crest low and inconspicuous, thin at middle and slightly rolled backward; anterior face not specially recessed to receive the tips of the gonopods.

Rhinocricus clypeatus new species

One male (type) and two females from Cueva del Aura 1500 to 3800 ft. elevation, Pico Turquino, Oriente Province, June 11, 1936.

Diagnosis. The gonopods indicate the intermediate position of this species between *R. sagittatus* and *R. gonolepis*, with the clypeate apical half of the median plate of the former species but lacking its free basal prongs, and having depressed, membraneous areas of the basal half common to both those species. The inner gonopods are unique in having the long upper branch greatly attenuated, the lower branch much stouter, its apex expanded. The ocelli are less numerous than in most species.

Description. Male more slender than the female, 38 mm long and 2.8 mm wide, a female 30 mm long and 3 mm wide; number of segments 46 to 53. Body in alcohol banded with two shades of brown, the fore- and hind-belt light brown except that the posterior margin of the latter is transparent; mid-belt dark brown, maculate with light spots from

below to a short distance above the pores, the remainder of the dorsum solidly dark brown.

Head with a short, fine sulcus on the vertex, another on the front. Ocelli large and rather few in number, in five series, 4, 5, 5, 4, 4, paralleling the first segment. Antennae quite slender, the first six joints subequal in width; joints 1, 2, and 6 subequal in length and very little longer than joints 3, 4, and 5, themselves of about equal length; sense cones four.

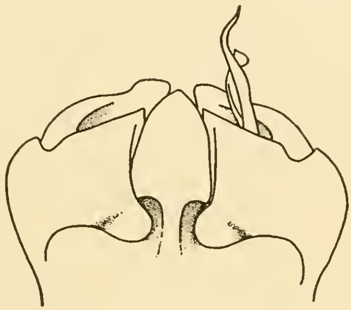

Fig. 7. *Rhinocricus clypeatus*. Gonopods, anterior view, with base of median plate lacking.

First segment evenly but rather narrowly rounded on the sides, the margin with a fine raised rim extending from the lower corner of the eye around the lower limits of the side.

Second segment with almost no shoulder below the limits of the first segment.

All segments from the second to the fifth from the posterior end of the body encircled by a strong sulcus which passes just behind the pore with a short bend; no lateral sulcus at line of pores; fore-belt with many fine transverse striae apparent only on the sides, the dorsum smooth; mid-belt and anterior two-thirds of hind-belt minutely reticulated, and dully shining, the posterior third smooth and brilliantly shining; ventral striae fine, continuing up the hind-belt almost or quite to the pore; scobinae present but rather small, continuing to about segment 15; posterior margin of the scobinate segments very slightly bisinuate.

Last segment as long at middle of dorsum as the three preceding segments together; apex closely applied to the anal valves, sharply angled, evenly produced backward from below. Anal valves mod-

erately inflated; margins thick, not specially raised, meeting in a groove; surface along the margins finely rugose, becoming smooth on the sides. Preanal scale large; apex angular in one specimen, rounded-angular in another, and intermediate in the third specimen.

Gonopods as shown in figure 7, the basal portion of the median plate broken in dissection but apparently much like that of *R. sagittatus* with each side membraneous, greatly depressed and scarcely distinguishable from the depressed and membraneous basal area of the lateral lobes. Inner gonopods with upper branch long, slender, acicular, slightly bent; lower branch shorter and heavier, the apex thin, expanded; no third or basal branch as in *R. sagittatus.*

Second male legs apparently not followed by a distinct penis as in *R. sagittatus* but dissection not made.

Male with coxae of legs 3 and 4 produced backward into triangular lobes, those of third legs largest; coxae of legs 5 and 6 normal; seventh coxae larger and thicker but not lobed; second joint of legs 3 to 5 slightly lobed below, the outer joints of these and the other pregenital legs normal.

Ventral crest of seventh male segment high and thick on the sides but at the middle it is thin and produced backward almost horizontally almost over the coxae of the ensuing legs.

Rhinocricus sagittatus new species

Four males (one the type) and one female from between 2500 and 3500 ft., Buenos Aires, Trinidad Mts., Santa Clara Province, May 14, 1936.

Diagnosis. Sharing with *R. clypeatus* the distinction of having the distal portion of the median plate of the gonopods developed into a sagittate lobe, but differing in having the lower corners of this lobe prolonged into free prongs. The modifications of the pregenital male legs are more extensive than in other American members of the genus.

Description. Length about 50 mm, width 4.5 mm; number of segments 49 to 50; mid-belt dark brown above with a small transverse white spot in front, half way between middle of dorsum and the line of pores, lower sides mottled with spots; hind-belt with anterior two-thirds light brown, posterior third colorless, transparent.

Head with vertex faintly furrowed at middle. Antennae rather short, moderately stout; joints 2 and 6 subequal in length but joint 6 wider than any other; sense cones four. Eyes composed of about 24 ocelli in five or six series parallel with the margin of the first segment.

Segment 1 broadly and evenly rounded on each side, having a very short raised margining rim below the eye along the anterior curve of the side; a lateral sulcus extends across the segment from behind the eye at the level of the lateral sulcus of the ensuing segments.

On the ensuing segments, to within six or seven segments of the posterior end of the body, a very strongly impressed sulcus encircles each

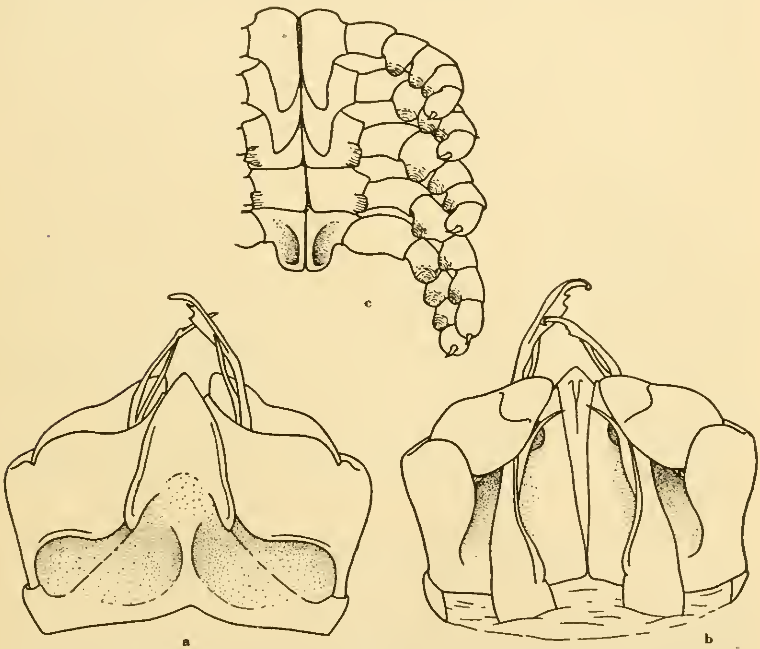

Fig. 8. *Rhinocricus sagittatus*. *a*, Gonopods, anterior view; *b*, Gonopods, posterior view; *c*, Legs 3 to 7 of male, ventral view.

segment between mid- and hind-belt just behind the pore; on segment 2, however, the sulcus reaches only to the line of the pores; lateral sulcus lightly impressed on mid-belt, strongly impressed on hind-belt; surface above pores somewhat shining but high magnification shows it to be very minutely pitted-reticulate with short longitudinal aciculations; ventral striae not surpassing distal end of legs. Scobinae present from segment 7 or 8 to segment 14, 15 or 16.

Last segment produced backward to a sharply angular apex which

equals the valves. Anal valves considerably inflated; margins not raised, meeting in a groove, the margins paralleled by many short, strongly impressed striae, frequently a longer, continuous stria outwardly bounding the margin causes it to appear separately raised. Scale rather large, rounded-angular at apex.

Gonopods with an unusual median plate having the basal half broad and greatly depressed below the apical half which is much narrower, and sagittate, with the basal prong or barb on each side free and projecting back over the depressed basal portion (Fig. 8*a*). Other particulars of the gonopods shown by figure 8*b*; the inner gonopods usually projecting outside of body. Behind the second legs of one male is a protruding penis of the same general shape as that in *R. etymophallus*. Dissection of one of the other males showed a similar penis withdrawn within the body cavity. Legs 3 to 7 of the males, as shown in figure 8*c*, with the four outer joints swollen, joints 3, 4, and 5 with a rounded, concentricly striate lobe on the under side; joint 2 elongated but not swollen; coxae of legs 3 and 4 produced backward into long lobes turned slightly outward; coxae of legs 5 and 6 flat and unusually broad, subquadrate, with a striate lobe at the outer posterior corner; coxae of seventh legs nearly as broad, produced backward and greatly raised along the disto-mesial side; legs 5 to 7 bent sharply caudad at the second joint, but this not evident in the drawing.

Ventral crest of seventh segment of the male sharply rolled backward, low and thin at the middle but high and thick on each side.

Rhinocricus perplicatus new species

A male (type) and a female from Cueva del Aura 1500–3800 feet elevation, Pico Turquino, Oriente Province, June 11, 1936.

Diagnosis. Distinguished from other non-scobinate species by the margined anal valves and the stout inner gonopods abruptly thickened at apex and with a small supplementary branch twisting behind the large inner branch.

Description. Length 32 mm, width 3 mm; number of segments of male 43; female 47.

Head dark along middle below the vertex, elsewhere light; first segment with narrow anterior margin light, followed by a short dark area longest at middle, interval light between this area and the very narrow dark posterior margin; ensuing segments with fore-belt light colored throughout; mid-belt black above to the line of pores below which it is maculate with light spots; hind-belt light golden brown on anterior

two-thirds, posterior third color-less, transparent; last segment dark above, maculate on the sides; anal valves dark, the raised margins light.

Head with vertex faintly furrowed at middle. Eye-patch circular, composed of 20 to 24 flat inconspicuous ocelli at the same level as the surface of the head, ocelli in five series parallel with the margin of the first segment. Antennae moderately long; joints 2 and 6 of equal length and longer than the other joints; joints 5 and 6 widest; sense cones four.

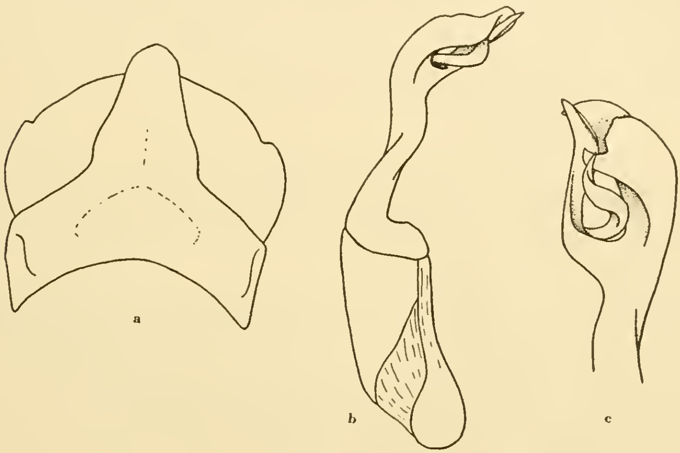

Fig. 9. *Rhinocricus perplicatus.* *a*, Gonopods, anterior view; *b*, Inner gonopod; *c*, Apex of inner gonopod from inner side with higher magnification.

First segment wider than those immediately following; the sides very broadly rounded, with a very short rim far below the eye not passing the lower limit of the side; surface smooth.

Second segment with a low rounded shoulder below the first segment.

Segments from the second to within five or six of the posterior end of the body encircled by a strongly impressed sulcus between mid- and hind-belt, scarcely bent to pass just behind the pore; surface behind the sulcus strongly convex, no lateral sulcus along line of pores; ventral striae not extending beyond tips of legs; fore-belt not striate, the anterior portion dull, the posterior half smooth and shining as are the mid- and hind-belts. Scobinae lacking, posterior margin of segments straight.

Last segment slightly produced and rather bluntly rounded at apex, not exceeding the valves. Anal valves strongly convex, with low and thin but definite raised margins paralleled by several coarse striae, those nearest the margin longest and most continuous, the outer ones interrupted. Preanal scale large and rather thick, rounded-angular behind.

Gonopods as shown in figure 9 *a*, *b*, and *c*.

Coxae of third male legs with rather thick rounded lobes, the next joint slightly swollen; following legs with similar specializations gradually reduced.

Ventral crest of seventh male segment strongly raised and rolled backward at middle, anterior face emarginate.

Rhinocricus sinuosus new species

One male (type), a female and four immature specimens from between 3000 and 4000 feet elevation in mountains north of Imias, Oriente Province, July 25–28, 1936.

Diagnosis. Relationship with *R. perplicatus* is indicated by the gonopods, but the presence of scobinae, the bisinuate posterior margin of the scobinate segments, and the lack of raised margins on the anal valves are outstanding differences and show effectively that these characters are of specific rather than generic importance.

Description. Male proportionally narrower than female, 35 mm long and 3 mm wide, with 47 segments; female 40 mm long, 4 mm wide, with 44 segments. Color in alcohol light brown, the mid-belt darker than the hind-belt, its sides maculate with light spots to a short distance above pores; posterior border of hind-belt transparent.

Vertex of head with a short, deep, median sulcus; front finely sulcate from margin of clypeus to a point directly between the antennal sockets. Eye-patch nearly circular, composed of flat, indistinct ocelli in five series paralleling the margin of the first segment — 5, 6, 5, 4, 2. Antennae slender; joints 1, 2, 3 and 6 subequal in length; joints 4 and 5 shorter; joint 6 broadest; sense cones four.

First segment, seen from the side, strongly convex longitudinally; sides broadly and evenly rounded, with margining rim for only a short distance along the anterior curve far below the eye; surface smooth and shining.

Second segment with scarcely any shoulder below the limits of the first segment.

Segments, from the third to within three or four of the posterior

end of the body, encircled by a very strongly impressed sulcus passing just behind the pore with a slight bend, this sulcus preceded at some little distance, on segments 3, 4, and 5, by a very fine sulcus or stria confined to the dorsal surface; lateral sulcus fine, evident only on the hind-belt which it crosses immediately behind the pore; ventral striae fine and not extending up sides of body beyond the limits of the legs; the legs small and weak with tips failing considerably to reach sides of body; fore-belt with annular striae faintly evident, surface shining; mid- and hind-belts smooth and shining; scobinae present from segments 8 to 16, the posterior margin of these segments deeply emarginate in line with the scobinae.

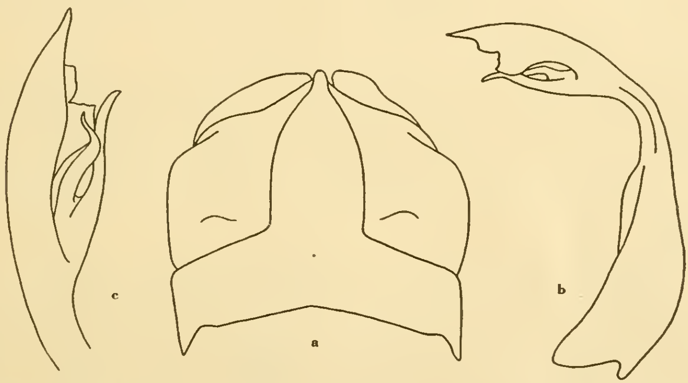

Fig. 10. *Rhinocricus sinuosus.* *a*, Gonopods, anterior view; *b*, Inner gonopod, same scale as *a; c*, Apex of inner gonopod, anterior view, with higher magnification.

Last segment with dorsum longitudinally convex, as the first segment; apex short but acute, thin and closely applied to the valves which exceed it. Anal valves moderately convex, the rather thick margins not elevated, meeting in a broad groove; surface smooth and shining. Preanal scale rounded-angular at apex, the margin either side slightly emarginate.

Gonopods showing the close affinity to *R. perplicatus* as seen in figure 10, *a*, *b* and *c*. the inner gonopods of these two species very large in proportion to the other parts of the gonopods.

Anterior male legs not crassate; third coxae with rounded lobes of moderate size; similar lobes decreasing in size on the next three pairs of coxae; seventh coxae normal.

Seventh male segment with ventral crest elevated for only a short distance at middle and distinctly rolled backward; ventral anterior margin of segment deeply concave but without an additional excision at the middle to receive the tips of the gonopods.

Rhinocricus pertenuis new species

Three males (one the type) and several young collected above the 5000 foot level on Pico Turquino, June 16–21, 1936. Other males from between 2000 and 5000 feet on south side of same mountain and a female from Cueva del Aura, Pico Turquino, June 11, 1936.

Diagnosis. This is the slenderest species of the family in the West Indies and in specimens with the maximum number of segments the number exceeds that of any other species there.

Description. Body very slender; the male type being 55 mm long and only 3.4 mm broad with 59 segments; another male is 50 mm long and 3.2 mm broad and has 61 segments; a tightly curled male has 64 segments; the female has 59 segments and is light in color but the legless penultimate segment indicates that maturity has not quite been reached.

Color of the mature alcoholic specimens solid black except the posterior third of the hind-belt which is light translucent amber.

Head faintly furrowed on vertex or not at all. Antennae short and stout (Fig. 11*a*); joint 2 distinctly the longest; ensuing joints about as broad as long; joint 5 slightly surpassing the others in width; sense cones four. Ocelli in a rounded cluster flush with the surface of the head, not convex, and very inconspicuous, numbering 18 to 22 in four series.

First segment very broadly and evenly rounded on each side; the raised rim weak and short, beginning far below the eye and extending scarcely beyond the lower limit of the side.

Second segment with a large evenly convex shoulder or hump below the first segment.

Ensuing segments with a strongly impressed sulcus encircling the body between mid- and hind-belt and bending very slightly to pass just behind the pore; surface on both sides of the sulcus smooth, shining, and equally convex and as the descent to the sulcus is the same as the descent of the posterior margin the sulcus easily may be confused with the margin, making segment counting difficult; fore-belt very minutely striate transversely and lacking scobinae; sides of segments without a sulcus at the line of the pores; ventral striae very few, confined to a

small area near the base of the legs and reaching upward only opposite the distal end of the third joint of the legs.

Segment 1 as wide as ensuing segments, the body parallel sided to near the back end where it is gradually attenuated; the last segment quite narrow and as long as the three preceding segments together,

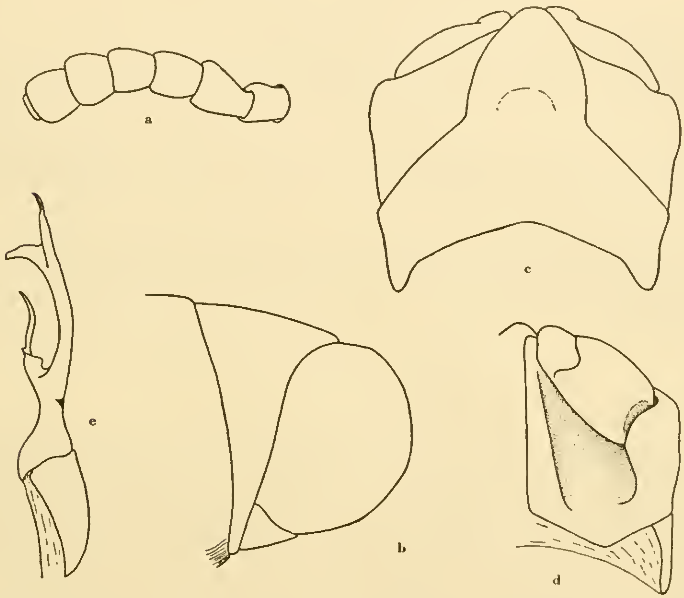

Fig. 11. *Rhinocricus pertenuis*. *a*, Antenna; *b*, Last segment, anal valves and preanal scale, lateral view; *c*, Gonopods, anterior view; *d*, Half of gonopods, posterior view; *e*, Inner gonopod, smaller scale than *c* or *d*.

the apex somewhat produced caudad but rounded rather than angular. The anal valves far surpass the apex of the last segment, as seen in figure 11*b*, and are laterally compressed with rather thin margins not separately raised but meeting in a narrow groove. Preanal scale slightly broader than long, subtriangular.

Gonopods as shown in figure 11 *c*, *d* and *e*.

First two pairs of male legs short and crassate, the coxae of the second pair enlarged and each with a conic lobe at the inner corner; coxae of third legs each produced backward into an apically rounded lobe as long as broad, the next two joints considerably swollen; fourth

legs similar to the preceding pair but with specializations less developed; ensuing legs normal.

Ventral crest of seventh male segment raised and rolled backward, its anterior face deeply emarginate.

Cubocricus suprenans Chamberlin

Bull. Mus. Comp. Zool., **62**, no. 5, p. 193, 1918.

Specimens referred to this species were collected in Oriente Province at the following localities: Ovando River, 1000–2000 ft., July 17, 1936; Yunque de Baracoa, 1000–1800 ft., July 13, 1936; Los Llanos, 1000–2000 ft., July 16–18, 1936; Mountains north of Imias, 3000–4000 ft., July 25–28, 1936.

They have numerous antennal cones. Scobinae present but not reaching the middle of the body, represented by a broad, short, depressed, subtriangular area of coarse, transverse striae not preceded by definite pits.

Cubocricus maximus Loomis

Bull. Mus. Comp. Zool., **75**, p. 358, 1933.

Received from the U. S. National Museum for identification were a score of specimens collected by Dr. Paul Bartsch in the Cubitas Mts., Camaguey Province, in 1929.

The specimens exhibit no characters of importance not mentioned in the original description, but permit a range in size and segmentation to be given. The largest specimen is a male with 56 segments, the maximum number, and is 210 mm long but apparently unduly relaxed by the preservative; the next largest male is not relaxed, has 55 segments, and is 200 mm long; the smallest male has 52 segments, the minimum number of the lot, and is 183 mm long; the females are from 182 to 190 mm long. Characters which seem of great importance in this species are the unpitted scobinae and the short margining rim of the first segment.

In the jar with the above specimens was a mature male, with 56 segments but only 140 mm long and 15 mm in diameter. In other particulars it resembled the other specimens except that the scobinae were complete from segment 8 to 20, each striate area being preceded by a short but broad pit not found in any of the typical specimens of *maximus*. This specimen may bear the same relationship to the typical *maximus* as does a small specimen with pitted scobinae, to

larger, non-pitted forms from the Isle of Pines which are here considered as a variety of *maximus*. Pits may not develop in normal specimens of the species and its new variety but may be called into expression by the retarded growth of the small specimens.

Cubocricus maximus bartschi new variety

Received from the U. S. National Museum about 30 specimens collected by Dr. Paul Bartsch in the Sierra de Casas, at the northwest end of the Isle of Pines, April 14, 1937. Male type in the U. S. National Museum.

No satisfactory means of distinguishing these specimens from the Cuban *maximus* have been found except the definitely smaller size and the usually shorter raised margin of segment 1, which is almost entirely lacking in some specimens. Majority of specimens about 150 mm long, females larger than the males, reaching 165 mm in length and 16 mm in diameter. Several mature males measure only 95 mm by 11 mm and one of these has fairly well developed pits preceding the striate areas of the scobinae; number of segments 50 to 53.

Spirostrophus naresi (Pocock)

Spirobolus naresii Pocock, Ann. and Mag. Nat. Hist., **11**, p. 252, 1893.
Trigoniulus naresi Brolemann, Mem. Zool. Soc. France, **13**, p. 94, 1900.
Trigoniulus remotus Chamberlin, Mus. Comp. Zool., **62**, no. 5, p. 212, 1918.
Spirostrophus remotus Chamberlin, Proc. U. S. Nat. Mus., **61**, no. 10, p. 14, 1922.

Although not a member of the Cuban fauna it is desirable to call attention to the position of *Spirostrophus remotus* (Chamberlin), described from Swan Island as a species of Trigoniulus but later removed by him to Spirostrophus.

On February 12, 1931, G. N. Collins and J. H. Kempton collected many millipeds on Swan Island but all belonged to a single species found to be *Spirostrophus naresi*, and as the specimens closely follow the description of *S. remotus* this species is here placed as a synonym of *S. naresi*. Described with *S. remotus* were two other species, *frater* and *garmani*, whose position with regard to *S. naresi* has not been determined.

In the National Museum collection are specimens of *S. naresi* collected in Jamaica in 1899 and the writer collected specimens at Castelton Gardens, Feb. 17, 1937. The species has not previously been reported from Jamaica.

MICROSPIROBOLUS MIMUS Chamberlin

Proc. U. S. Nat. Mus., **61**, Art. 10, p. 12, illus., 1922.

Three males and one female collected at about 1500 feet elevation, Sierra de Rio Province, August 23–24, 1936.

This species has not been reported since its founding on a single male specimen. Slight differences shown by the present specimens are given below.

The female, and largest specimen, is 33 mm long and has 53 segments; the males have 49, 52 and 55 segments; the latter specimen

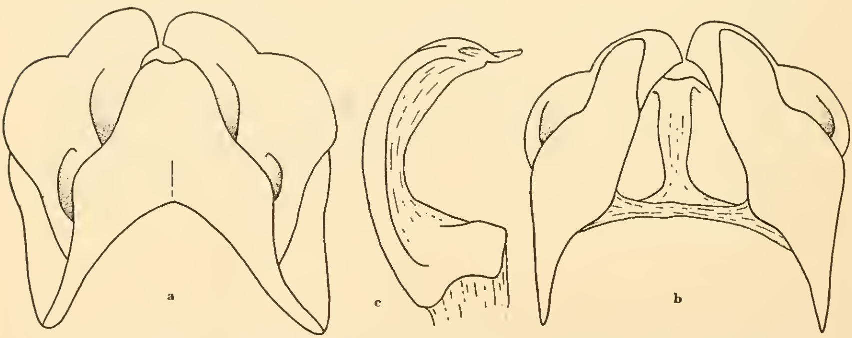

Fig. 12. *Microspirobolus mimus.* *a*, Gonopods, anterior view; *b*, Gonopods, posterior view; *c*, Inner gonopod.

having 37 ocelli in six series. Color lighter than that of the type specimen, the fore-belt nearly white, mid-belt dark brown, hind-belt semitransparent amber, allowing the color of the fore-belt of the next segment to show through.

The gonopods, shown in figure 12 *a*, *b* and *c*, are peculiar in that the lateral lobes conceal all but the outer basal portion of the posterior lobes. The disto-mesial productions of the lateral lobes, which overlap considerably when the gonopods are *in situ,* are strongly curved forward toward the median plate.

MICROSPIROBOLUS UNDOSUS new species

Many specimens from between 5000 feet and the summit of Pico Turquino, June 16–21, 1936. Type, a male.

Diagnosis. Outwardly distinguished from other species by the roughened segments and the continuation of the ventral striae up and

across the dorsum on the anterior half of the segments. The gonopods indicate affinity with *M. belonanus* Chamberlin, a lighter colored species.

Description. Length 20 to 25 mm; the males smaller than the females; number of segments 44 to 47.

Color in general almost black with small but conspicuous white markings; head with labral region light brown, elsewhere black; first segment black except for a narrow, sharply defined, white anterior

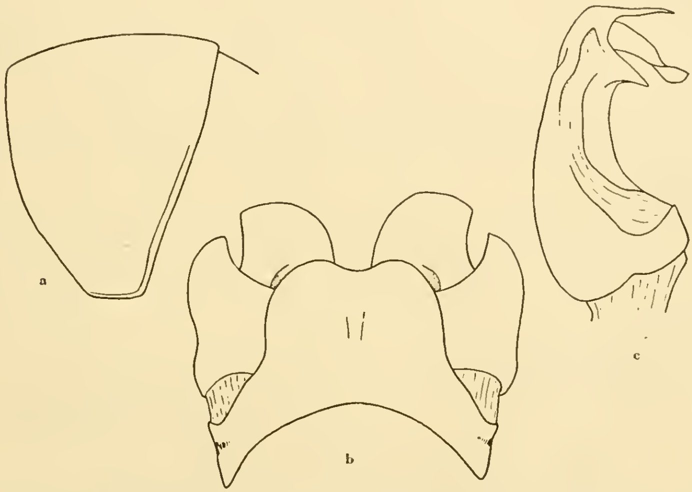

Fig. 13. *Microspirobolus undosus.* *a*, Segment 1, lateral view; *b*, Gonopods, anterior view; *c*, Inner gonopod.

border usually broken at the median line; second and third segments usually black but the ensuing segments each have two small white spots on each side of the dorsum, the outer one most conspicuous and located in the transverse constriction closer to the line of the pores than to the middle of the dorsum; inner spot slightly smaller, above and in advance of the other, and well in front of the transverse constriction and covered by the preceding segment, through which it is quite plainly visible; last segment with a much larger white spot on each side than the other segments, this partly covered by the foregoing segment; anal valves light along the margins.

Vertex of head finely sulcate. Eyes composed of 24 to 34 well defined ocelli in four rows or less frequently five rows paralleling the

margin of the first segment. Antennae slender, joints 2 and 6 subequal in length but joint 6 apically wider than any other.

First segment rather squarely truncated on each side and with definite anterior and posterior corners; a narrow margining rim begins just behind the eye and continues down and around to the posterior corner (Fig. 13*a*); lateral surface usually somewhat depressed.

Principal body segments encircled at middle by a broad and deep transverse constriction, the surface behind it longitudinally undulate-rugulose, rougher than in any other species yet seen but somewhat shining; ventral striae strong, those approaching the pores with anterior ends bending upward and forward and some completely crossing the dorsum in a narrow, coarsely anastomosing network in the constriction or just in advance of it.

Last segment quite acute at apex but not surpassing the valves. Preanal scale broadly rounded behind, more nearly a semicircle than a triangle.

Gonopods with the median plate especially broad (Fig. 13*b*); posterior lobes broad and thin, apices bent caudad; inner gonopods more nearly like those of *M. belonanus* than any other species (Fig. 13*c*).

Anterior male legs not conspicuously different from those of the female, lacking coxal lobes.

Seventh segment of male scarcely raised behind the gonopods.

Microspirobolus conspicillatus new species

A mature male (type), two females, and several younger specimens from the coast below Pico Turquino, June 26–30, 1936.

Diagnosis. This seems to be the only species with segments striate in front of the constriction but smooth and shining behind it. It is closely related to *M. belonanus* Chamberlin, as the rather slight differences of the gonopods of the two species show, but has several more segments and somewhat different coloration, also the antennae are more slender and joint 6 is almost parallel-sided and not "much thickened above a slender base" as said of *M. belonanus.*

Description. Male 24 mm long and 2 mm wide; 47 segments. Largest female 32 mm long and 2.3 mm wide; 51 segments; other female with 49 segments.

Head black above, a narrow white band connecting the white antennae, lower part of head dusky; first segment entirely surrounded by a light marginal band broadest along the anterior margin, where

it is apricot color, the posterior band more nearly white; posterior half of the ensuing segments transparent creamy white throughout; anterior half of segments black to the line of the pores except for an apricot colored spot on each side in front a little above the line of the pores and beneath the preceding segment; surface below the pores almost wholly light colored with a strongly emphasized, long, transverse, apricot colored spot near the front margin and beneath the preceding segment; last segment light on the sides and narrowly along the back margin below the apex, apex and remainder of surface dark;

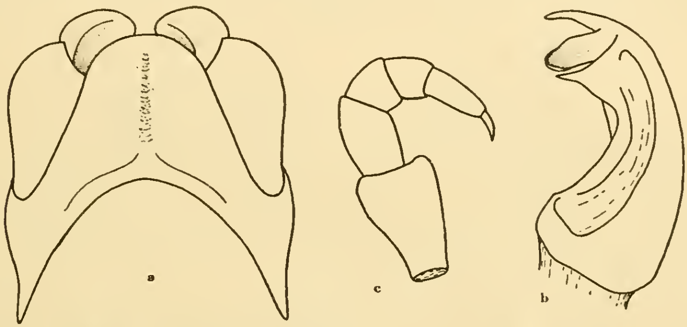

Fig. 14. *Microspirobolus conspicillatus.* *a*, Gonopods, anterior view; *b*, Inner gonopod; *c*, Leg 3 of male.

anal valves with sides dark, margins and lower parts light next to the light colored preanal scale.

Head with long, slender antennae, the sixth joint scarcely broader than the three preceding joints and not longer than joint 2, the basal portion not constricted as in *M. belonanus;* vertex unimpressed. Ocelli in five or six series nearly paralleling the margin of segment 1, beginning at the antennae the ocelli are arranged in series as follows: 3, 5, 7, 8, 10 or 2, 4, 6, 9, 10, 10.

First segment narrowly and sharply rounded on the sides and with the usual rim along the side and up the front margin to the eye.

Ensuing segments with a broad and rather deep transverse constriction containing a definite sulcus on the anterior segments but not on the others, but on the latter some of the ventral striae are carried up and irregularly across the dorsum in front of the constriction; posterior half of the segments high, strongly convex, smooth and brilliantly shining.

Last segment not exceeding the valves which have rather thick margins and meet in a deep groove. Preanal scale more nearly semicircular than triangular.

Gonopods somewhat like those of *M. belonanus* but several differences will be observed on comparing figure 14, *a* and *b* with Chamberlin's figures.

Ventral crest of segment 7 of male low and thick, broadly emarginate in front.

Coxae of anterior male legs not modified, similar to those of the female, but the next joint of legs 3 to 5 is expanded vertically downward, especially at the distal end (Fig. 14*c*).

Microspirobolus mucronatus new species

Nine specimens, including the male type, from 3000 to 3800 feet elevation, Sierra de Cobre, Oriente Province, July 3–7, 1936.

Diagnosis. The form of the inner gonopods attests relationship of this species with the series containing *M. belonanus, undosus,* and *conspicillatus* but it is distinguished from all West Indian species by the strongly mucronate last segment.

Description. Body composed of 43 to 45 segments; males smaller and more slender than the females, largest male 28 mm long, 2.2 mm thick, largest female 36 mm long and 3.3 mm thick.

Head dark brown; first segment margined anteriorly with a broad band of white which narrows and continues around the sides and up the posterior margin almost to the middle of the dorsum; inner surface, including the median posterior margin, dark brown; ensuing segments with a broad longitudinal median brown band bordered by a band of white or light yellow more or less broken into spots depending on the degree of coloring, as it is more interrupted on the fullest colored specimens, below this band the sides are light brown and somewhat irregularly blotched with still lighter brown; last segment dark except for a large white spot in front on each side beneath the penultimate segment; anal valves moderately dark with light margins.

Head with vertex faintly sulcate anteriorly, unimpressed behind. Antennae slender; joint 2 as long or a little longer than joint 6, the latter with base constricted but the distal end wider than the other joints. Ocelli 26 to 37 in four or five series. Labral pores 4–4.

First segment evenly and rather narrowly rounded on each side; a strong rim extending from behind the eye around the side and somewhat up the posterior margin; lateral surface with two or three striae

proceeding forward from the posterior margin just above the termination of the raised rim.

Ensuing segments with a broad, deep, transverse constriction containing, on eight or ten of the anterior segments, a sulcus which is lacking on the other segments or sometimes is replaced by one of the striae carried up from the ventral surface; several of these striae are bent upward and cross the dorsum in front of the constriction but are more broken up and show less tendency to form a network than those of *M. undosus;* the posterior half of the segment is higher than in that species but the sculpturing is essentially the same although of finer texture.

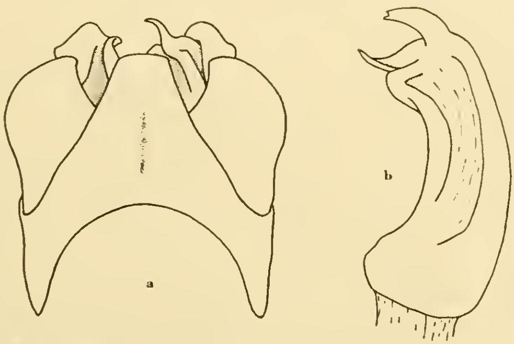

Fig. 15. *Microspirobolus mucronatus.* *a*, Gonopods, anterior view; *b*, Inner gonopod.

Last segment strongly produced beyond the anal valves in an acute mucro. Margins of anal valves thick and meeting in a broad deep groove. Preanal scale long, rounded-triangular.

Male gonopods with posterior lobes excavated on the inner anterior face to receive the inner gonopods and with the thickened apex obliquely grooved (Fig. 15*a*). Inner gonopods shown in figure 15*b*.

Seventh male segment with ventral crest low, emarginate at middle in front.

Anterior male legs without lobes or prominences on coxae or other joints.

Family STRONGYLOSOMIDAE

Orthomorpha coarctata (Saussure)

Specimens from Los Llanos and vicinity, 1000–2000 feet elevation, eastern Oriente Province, July 16–20, 1936.

Leiomodesmus new genus

Type. L. flavocinctus new species.

Diagnosis. Although based on a female specimen, the almost complete lack of lateral carinae from segment 5 backward, and the smooth metazonites, without a transverse median depression, are principal characters found in no other genus of the family in this hemisphere and justify erecting a separate genus for this species without the examination of males. However, until males are seen, its affinites must remain uncertain.

Description. Body rather small, slender, cylindric, with lateral carinae scarcely indicated; metazonites smooth and shining, not crossed by a transverse depression.

Head with long vertical sulcus; antennae slender but rather short, the first joint thicker than any other, the following five joints nearly alike in length and thickness as shown in figure 16*a*.

First segment thickly lenticular in outline, descending to an acute angle on each side. Second and third segments not noticeably different in size from those that follow; the second with a thin carina on either side extending well below the angle of the first segment, its anterior corner squarely rounded, outer margin straight, posterior corner slightly produced backward; third and fourth segments with carinae a little higher and increasing in thickness, the posterior corners produced; from segment 5 to the caudal end of the body the carinae are indicated merely by broad but slight swellings of the lateral surface, limited above by an impressed stria, the pores opening outward from the posterior part of the swelling; on the anterior segments there is a pleural swelling near the base of the legs but no distinct ridge.

Last segment with apex produced straight backward beyond the anal valves; the valves with thickened margins; preanal scale of medium size, somewhat thickened, round-angular behind.

Legs quite small and short, the two outer joints densely hispid; sterna broad, low, flat, not sulcate in either direction.

Leiomodesmus flavocinctus new species

A single female from El Yunque de Baracoa, 1000 to 1800 feet elevation, Oriente Province, July 13, 1936.

Description. Body cylindric, 17 mm long, 2.2 mm in diameter.

Head and antennae very light brown; first segment white except for a large dilute brown spot on each side near the front; ensuing segments

white with an annulus of chestnut brown including the posterior third of the prozonite, and somewhat more of the anterior part of the metazonite, especially in the region of the lateral carinae, the annulus extending to the base of the legs; last segment, anal valves, preanal scale, ventral surfaces, and legs white.

Head having the front slightly depressed between the antennal sockets, a long erect seta just above the depression on each side and a similar pair, more widely separated, below the antennae; clypeal region with a few scattered setae above the marginal row; labrum with a row of very closely placed setae.

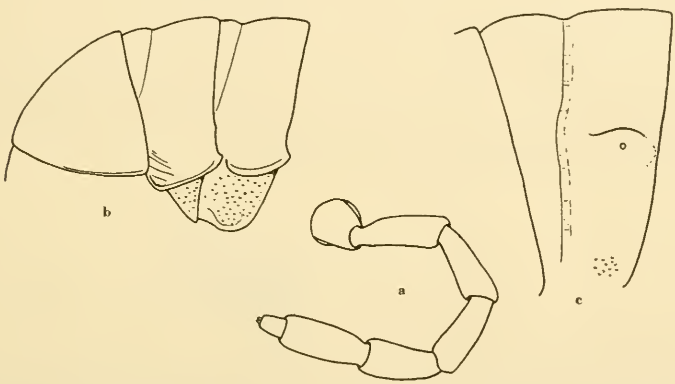

Fig. 16. *Leiomodesmus flavocinctus*. *a*, Antenna; *b*, Segments 1, 2 and 3, Lateral view; *c*, Segment 9, lateral view, same scale as *b*.

Anterior segments as shown in figure 16*b;* the first segment with a very fine rim along the anterior margin from the angle almost half way to the middle of the dorsum; second segment with a more elevated rim extending downward around the anterior corner of the carina and backward to the produced posterior corner, the posterior margin with a tiny tooth a little above the corner; inside the anterior corner are several fine, short, obliquely descending striae; third and fourth segments with lateral carinae higher and with increasingly thicker margins, the posterior corners decreasingly produced; from segment 5 to the penultimate segment the carinae are greatly reduced, rudimentary, indicated by broad, low, elongate-oval swellings with the upper limit marked by a stria, the lower limits verging imperceptibly with the side, the posterior corner elevated slightly but not at all prominent or

produced backward; poriferous carinae broader than the others, the upper limiting stria strongly bowed upward, instead of being straight, the pore opening from above the middle of the carina in its posterior half (Fig. 16*c*). Prozonites slightly more convex than the metazonites, separated by a sharply defined constriction, the surface of both smooth and brilliantly shining, the metazonite lacking a transverse median depression. Anterior segments with the usual pleural ridge replaced by a large, low, circular swelling beginning on segment 3 and gradually decreasing thereafter to segment 14 or 15; segments 2 and 3 with the sides granular from the carinae to the base of the legs, on ensuing segments the granules gradually restricted to the lower sides and finally vanishing on the posterior half of the body.

Legs small and rather weak, the two inner joints stouter than the outer ones, joint 3 longest, nearly as long as the three outer joints combined; the other joints decreasing in length in the following order: 2, 6, 1, 4, 5; four basal joints with few hairs, the two outer joints densely hispid, sterna broad; low, flat, non-sulcate.

Family CHELODESMIDAE

Amphelictogon cubanus Chamberlin

Bull. Mus. Comp. Zool., **62**, no. 5, p. 224, 1918.

A paratype female, M.C.Z. No. 4485, has the repugnatorial pores opening almost laterally from the thickened margin but not from a special callus.

The direction in which the pores open, and whether or not they are borne in special calluses or in the more or less thickened but otherwise unmodified margins of the carinae, are characters subject to more variation in Amphelictogon than is ordinarily observed in a single genus, and are of much greater importance than usual in distinguishing the species.

Amphelictogon propinquus new species

A dozen specimens, including the male type, from the south side of Pico Turquino, 3800 to 5000 feet elevation, June 1936; other specimens from Cueva del Aura, Pico Turquino, 1500 to 3800 feet elevation, June 11, 1936; one female from Rio Frio, Boniato Range, Oriente Province, June 5, 1936.

Diagnosis. Very closely related to *A. couloni* and resembling it in most particulars but distinguished by several differences of the gonopods as shown by comparison of the accompanying figure with that drawn by Carl for *A. couloni.*[1]

Description. Largest female 43 mm long, 6 mm broad, strongly convex, parallel sided; the males smaller and more flattened, the sides not noticeably converging caudad, almost as nearly parallel as in the female.

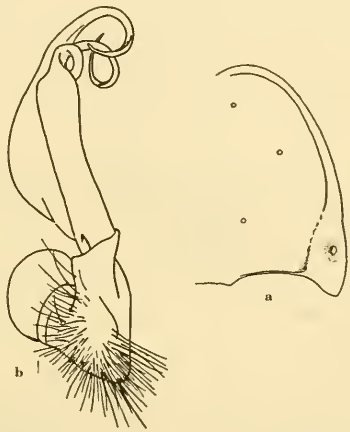

Fig. 17. *Amphelictogon propinquus.* *a*, Carina of segment 9 of male; *b*, Gonopod.

Body colored as in other specimens from the Cueva del Aura and identified as *A. couloni;* a broad, white, mid-dorsal band continuous from the front margin of segment 1 to the apex of the last segment, the band constricted at the middle of the first segment but elsewhere of uniform width, on either side of the median band the color of both subsegments is dark brown and on the metazonite extends more or less onto the carinae, sometimes including all but the posterior corner; head entirely dark brown, the labral region scarcely lighter than the front or vertex; antennae light red; legs with outer joints faintly tinged with pink.

Segments seldom with a transverse depression indicated on the metazonites of either sex; lateral carinae prominent, those of segments

[1] Rev. Suisse de Zool., **11**, p. 552, pl. 16, fig. 13, 1903.

2 to 4 usually with an acute tooth at the anterior corner, those on the mid-body segments with a tooth on the posterior margin and frequently with a less distinct prominence a short distance mesad of it; posterior corners acute, strongly produced backward on the caudal half of the body, those of the penultimate segment small but acute; surface of carinae with several more or less apparent granules, surface of mid-dorsum smooth. Pores large, opening almost straight upward from a circular depression in the large, continuous, broadly expanded lateral margin which does not have a special pore callus set off on it (Fig. 17*a*), the thickened, expanded margin, however, contrasts strongly with the thin rim and sharper angle of the non-poriferous segments.

Preanal scale rounded-angular behind, the apex with a supplementary tip.

Gonopods as shown in figure 17*b*, differing from those of *A. couloni* in having the outer basal portion of the anterior arm less abruptly produced and the apex shorter and acute; the posterior arm has the basal portion straighter and more slender.

Sternum between the third male legs lacking processes, the other legs and sterna normal.

Amphelictogon couloni (Humbert & Saussure)

Polydesmus couloni Humbert & Saussure, Rev. et Mag. de Zool., p. 151, 1869.

Three males of this species from Cueva de Aura, 1500 to 3800 feet elevation, Pico Turquino, Oriente Province, June 11, 1936.

In size, color, form of lateral carinae and location of the pores, this species resembles *A. propinquus* but it lacks the tooth at the anterior corner of segments 2, 3 and 4, which is usually present in *A. propinquus;* surface of the carinae seldom with nodules as in that species.

Amphelictogon guantanamanus Chamberlin

Bull. Mus. Comp. Zool., **62**, no. 5, p. 228, 1918.

Paratype specimens, M.C.Z. no. 4499, from Guantanamo and Belig, have been inspected and the gonopod of a male from the former locality is shown in figure 18. The distal, posterior margin of the anterior branch of the gonopod is very thin, hyaline, the apex trun-

cated. Chamberlin states that the two anterior branches touch at middle but do not cross, however, in three males examined these branches were crossed and interlocked. From the form of the gono-

Fig. 18. *Amphelictogon guantanamanus.* Gonopod of paratype male.

pods it is obvious that this species is closely related to *A. couloni, flavipes* and *propinquus.*

The repugnatorial pores open directly outward from the scarcely thickened margin of the carinae, no special callus being formed.

Amphelictogon flavipes Chamberlin

Bull. Mus. Comp. Zool., **62**, no. 5, p. 229, 1918.

A paratype male and female, M.C.Z. no. 4501, have been examined.

The gonopods cannot be distinguished from those of *A. guantanamanus,* here shown in figure 18, although the remark "The gonopods of the male are very distinctive" would lead one to suppose they were not approximated by any other known species. In comparing the above specimens with paratype specimens of *A. guantanamanus* the only structural difference observed was in the location of the pores, those of *A. flavipes* opening obliquely upward from a slight callus.

AMPHELICTOGON OBSCURUS Chamberlin

Bull. Mus. Comp. Zool., **62**, no. 5, p. 226, 1918.

Paratype specimens, M.C.Z. no. 4490 & 4491 have been examined. The most striking feature of this species was not mentioned in the original description, i.e., the great difference in coloration of the poriferous segments from those lacking pores. The prozonite of all segments is dark brown but the metazonite of the poriferous segments is wholly yellow except that on segment 18 the dark color of the prozonite extends somewhat backward onto the metazonite, and on segment 19 includes most of it; except for segment 1, which is yellow

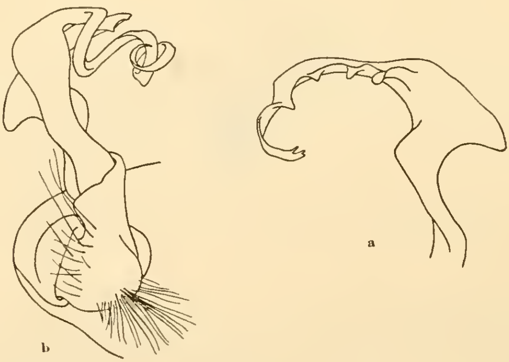

Fig. 19. *Amphelictogon obscurus*. *a*, Apex of anterior branch of gonopod; *b*, Complete gonopod, except that tip of anterior branch has been broken off.

with a small dark spot on each side of the middle, and the last segment, which is dark in front and yellow behind, the nonporiferous segments are almost entirely dark brown, only segments 2 to 4 are relieved by yellow areas at the posterior corners of the carinae. Somewhat similar color differences between segments with and without pores have been noted in *A. bidens* Loomis, from the Bahama Islands.

The pores open obliquely upward from a slight callus.

An anterior branch of a gonopod is shown in figure 19*a*. A complete gonopod from the opposite side of the body is shown in figure 19*b*, but the extreme tip of the anterior branch has been broken off; the posterior branch shows the twisted tip in but one of the positions it may assume, for in several males examined each had the tip coiled in a different manner.

AMPHELICTOGON PALLIDIPES Chamberlin

Bull. Mus. Comp. Zool., **62**, no. 5, p. 228, 1918.

Chamberlin mentioned that the gonopods of this species most closely resembled those of *A. subterraneus*, but from the differences he gave it would seem that much greater similarity existed with those of *A. obscurus*, as shown in the preceding figures. He further stated that "in size and general appearance" *A. obscurus* suggested *A. pallidipes* but had darker legs and antennae.

AMPHELICTOGON STRUMOSUS new species

Three males, one the type, and four females from Buenos Aires, 2500 to 3500 feet, Trinidad Mountains, Santa Clara Province, May 8, 1936.

Diagnosis. Closely related to *A. subterraneus* (Sauss.) but apparently with more color; surface of the first segment elevated into a broad, low ridge behind the front margin; and the mesial side of the basal portion of the posterior branch of the gonopod with two teeth instead of one.

Description. Males moderately convex, the largest one 28 mm long and 3.5 mm wide, sides of body converging backward from segment 2; females very convex, attaining a length of 30 mm and a width of 4.5 mm; sides of body parallel.

Head brown on vertex and front; dorsum of anterior and posterior subsegments broadly yellow at middle except that on the first four segments the median band narrows anteriorly and is very narrow at the front margin of segment 1 which has a large brown spot on either side; ensuing segments with a large brown spot on each side of the anterior subsegment and continuing back somewhat less extensively onto the dorsum and basal portion of the carina of the metazonite but not reaching the posterior margin; ventral surfaces, legs and basal joints of antennae yellow; in specimens not fully colored the metazonites and carinae are wholly yellow.

First segment with a broad ridge-like swelling, usually more prominent in the female, beginning a little above the lateral angle and continuing across the segment just behind the front margining rim, the rim itself however not continuing across the median third.

Segments from the first to near the back end of the body with several small nodular tubercles on the carinae and sides of the dorsum and, in addition, the first few segments may be coarsely rugose in the

same region; a small tooth is evident only at the anterior corner of the carinae of segments 4, 5 and 6, or not at all, and on the mid-body segments a small tooth usually is evident on the posterior margin of the carinae near the base; carinae small as compared with other species, the posterior corners square and not produced backward until on the caudal segments; carinae of the penultimate segment entirely

Fig. 20. *Amphelictogon strumosus.* Gonopod.

lacking or at most represented by a low ridge fading into the surface behind, instead of projecting in a sharp angle; pores strictly lateral, opening outward from the margin almost at its posterior corner and lacking a special callus, the margin only a little thicker than on the nonporiferous segments; transverse depression of metazonites faintly indicated in the males and less so in the females.

Gonopods as shown in figure 20.

Sternum between third male legs with two small conic tubercles; other legs normal.

Amphelictogon atricolor new species

A broken male, type, and two females from 1000–1800 feet elevation, El Yunque de Baracoa, Oriente Province, July 13, 1936.

Diagnosis. The almost solid black of the dorsum; acute posterior angles of the lateral carinae; the shape of the male gonopods, expecially the scarcely bent, forwardly produced anterior branch; and the thickened caudal legs; are this species chief distinctions.

Description. Female 29 mm long, 4 mm broad, moderately convex; the lateral carinae continuous with the dorsum, slightly descending; male smaller and more slender and with the dorsum nearly horizontal; the lateral carinae horizontal or a little obliquely raised, joining the side of the dorsum at a distinct angle.

Color almost completely black; head black except at labral margin; first segment black with only the anterior margin narrowly amber-transparent; ensuing segments with the anterior subsegment black above, lighter near the legs, posterior subsegments solidly black except

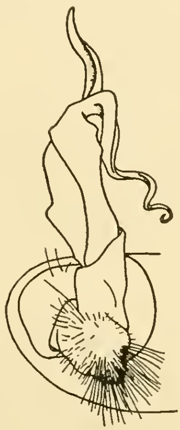

Fig. 21. *Amphelictogon atricolor.* Gonopod.

the lateral margining rim and the posterior angle of the carinae which are transparent amber colored, the lighter color more conspicuous on the poriferous segments as all the thickened margin is included; outer joints of legs and antennae light red, basal joint lighter; anal valves light brown, the scale uncolored.

First segment of typical shape, broadly rounded in front, strongly biarcuate behind, bordered with a prominent raised rim on front and back margins except for a short distance at middle.

From the second to the seventh or eighth segment there is a sharp tooth at each anterior corner, and beginning with the second segment the posterior corners are acute and produced backward, especially as the posterior end of the body is approached, the posterior margins of the carinae have no teeth but just above the margin an inconspicuous

nodular tubercle sometimes swells the margin, forming a slight prominence; carinae with inner surface swollen, especially on the anterior segments, and with one or two small nodules in front and several others on the adjacent side of the dorsum; beginning with segment 5 of the male the posterior subsegment is crossed transversely by a broad, shallow depression which is scarcely evident in the female; pores directed laterally and slightly upward from the strongly thickened, continuous margin which has no specially developed pore callus, however.

Anal valves with slightly thicker, more elevated margins than in the other species examined. Preanal scale triangular, its lateral margins and apex a little thickened.

Gonopods as shown in figure 21.

Pregenital legs of the male without specializations except that there are two small conic tubercles on the sternum between the third legs. Most unusual, however, the four outer joints of the legs of the last two pedigerous segments are distinctly heavier, and with stronger claws than on foregoing segments; females with a slight indication of the same condition; in no other species of the genus has this phenomenon been observed.

Amphelictogon flexus new species

The male type and several badly broken specimens from 3000 to 4000 feet elevation, mountains north of Imias, Oriente Province, July 25–28, 1936.

Diagnosis. The sharply upturned posterior corners of the mid-body segments; the small but sharply defined pore calluses; and the form of the gonopods identify this species.

Description. Length of largest male 32 mm, width 4.5 mm, dorsum slightly convex; females, although broken, obviously a little longer, and wider in proportion than the males, dorsum strongly convex.

In the fully colored specimens the head is dark chestnut brown on the vertex and between the antennae, the sides and labral region lighter; first segment almost entirely white, with only a small, very dilute, brown spot near the middle on each side; ensuing segments largely white, a dark brown spot on each side partly on the prozonite and partly on the metazonite at the junction of the lateral carina with the dorsum; other specimens with lessening degrees of color, some being entirely white.

Lateral carinae small, especially in the females (Fig. 22*a*), not pro-

jecting far from the sides of the body; beginning with segment 2 the posterior corners are acute and slightly but increasingly produced backward, reaching the maximum development on segments 17 and 18; carinae of segment 19 large for the genus, produced considerably behind the margin; on the median half of the body the posterior corners of all segments are sharply tilted upward; segments 2 to 7, or even somewhat beyond, with a small sharp tooth at the anterior corner; from segment 3, 4 or 5 to segment 15 or 16 a tooth is present on the posterior margin of the carina where it joins the body, and on some of the mid-body segments this tooth is quite large and somewhat raised;

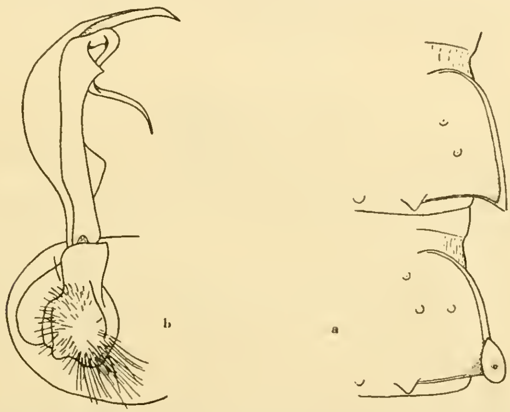

Fig. 22. *Amphelictogon flexus*. *a*. Lateral carinae of segments 11 and 12, dorsal view; *b*, Gonopod.

mesad of this tooth a small tooth-like nodule occasionally is present near the margin; surface of carinae and adjacent sides of the dorsum with a variable low number of nodular tubercles; on the posterior segments additional nodules are present on the middle of the dorsum especially near the hind margin; metazonites of the male crossed by a faint median depression not present in the females. Pores opening from the outer face of a small, short but thick, abruptly raised callus which is held obliquely upward on the mid-body segments, fully exposing the pore from above; in the female the pore calluses are smaller but more sharply set off from the margin than in the male and often more elevated.

Preanal scale rounded behind but with a tiny accessory tip.

Gonopods as shown in figure 22*b*.

Sternum between the third male legs swollen on either side but not raised into tubercles; other legs and sterna normal.

Amphelictogon sp.

A female from Buenos Aires, 2500–3500 feet elevation, Trinidad Mountains, Santa Clara Province, May 8–14, 1936.

Although this specimen has several minor characters which seem to distinguish it from any species thus far recognized, the fact that it is a female makes it inadvisable to name it as new and further complicate a genus in which superficial characters are not always sufficient for absolute identification of the species.

Amphelictogon sp.

Three females from 3000 to 4000 feet elevation, mountains north of Imias, Oriente Province, July 25–28, 1936.

Not referable with certainty to any described species but with characters which might allow its inclusion in one of several species.

Cubodesmus limoneus Chamberlin

Bull. Mus. Comp. Zool., **62**, no. 5, p. 242, 1918.

Paratypes M.C.Z. No. 4523 and 4524 have been examined.

The crenate rim at the anterior margin of the clypeus is less evident than that in *C. latior;* the first segment of the same shape as in that species but the anterior margining rim does not cross the middle of the segment. Preanal scale triangular, with a tiny supplementary apical point, the posterior half of the scale scarcely swollen. Gonopods closely resembling those of *C. latior*, the only obvious difference is that the inner corner of the anterior arm has a short, acute tooth, like that in *C. prominens*.

Cubodesmus latior Chamberlin

Bull. Mus. Comp. Zool., **62**, no. 5, p. 239, 1918.

The Los Hondones paratype, M.C.Z. No. 4516, has been examined and one of the gonopods drawn, figure 23. The front margin of the clypeus has a distinct rim of small raised scallops, behind which the

clypeal setae are scattered. Median third of the anterior margin of segment 1 is straight across, only the lateral third on each side being curved; raised rim continuous across the entire margin although less

Fig. 23. *Cubodesmus latior.* Gonopod of paratype male.

conspicuous at middle. Preanal scale with an indefinite depression across the middle, the surface behind slightly inflated but far from as much as in *C. prominens.*

Cubodesmus prominens new species

Male type and female from Los Llanos, eastern Oriente Province, July 16–18, 1936; several males and females from El Yunque de Baracoa, 1000–1800 feet elevation, July 13, 14, 1936; two females from mountains north of Imias, 3000–4000 feet elevation, July 25–28, 1936.

Diagnosis. A more completely dark colored species than any previously known and one without teeth on the lateral carinae. In none of the descriptions of the other species, specimens of two of which have been examined, is mention made of an apically swollen preanal scale such as possessed by the present species, although examination of paratype specimens of *C. latior* and *C. limoneus* showed the former possessed of a slightly swollen scale.

Description. Body large but relatively narrow, more convex than in *C. latior* or *C. limoneus;* the largest specimen, a female, 53 mm long and 8.5 mm broad; females with sides almost parallel from the second to

the fifteenth segment, the males more slender, less convex, and very gradually narrowing caudad from segments 2 and 3, which are the widest.

Color in fully mature specimens universally darker than the other species, head dark brown on vertex and front, the sides, clypeus and labrum light reddish brown; first segment dark throughout; ensuing segments with the prozonite light brown at its front margin, gradually darkening behind to the very dark brown, almost black color of the metazonite which has only the pore calluses relieved by light yellowish brown, the posterior corners of the non-poriferous segments almost as

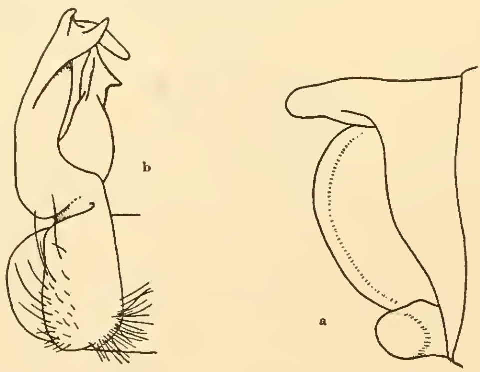

Fig. 24. *Cubodesmus prominens.* *a*, Last segment, anal valves and preanal scale of female, lateral view; *b*, Gonopod.

dark as the dorsum; last segment with the apex light yellowish brown as are the anal valves and preanal scale; antennae and outer joints of legs light pink; sterna light brown.

Head with clypeal region beset with scattered setae, the anterior border not raised into a distinct ridge as in *C. latior*.

First segment evenly rounded across the entire anterior border, the raised rim crossing only each lateral third.

Ensuing segments with surface very finely reticulated or shagreened, causing it to have a dull luster rather than shining brilliance, lacking quadrate areas or tubercles; lateral carinae much less produced outward than in either of the other two species examined, wholly lacking marginal teeth, pores opening obliquely upward and backward from a large depressed area in the broad callus, the caudal limit of which is rounded, much more so than in *C. latior* or *C. limoneus*, in distinct

contrast to the squarely angled corners of the non-poriferous segments; on only the last few segments are the posterior corners of the carinae produced beyond the posterior margin, carinae of segment 19 smaller than in *C. latior* but slightly produced.

Preanal scale subtriangular in shape but remarkable in having the apical portion greatly inflated, appearing almost bulbous in lateral view, figure 24*a*, the name of the species referring to this condition.

Gonopods, shown in figure 24*b*, differ only in minor details from those of *C. latior* and *C. limoneus*. In the specimens from El Yunque de Baracoa the mesial, subapical tooth of the anterior branch is reduced and in one specimen is missing.

Sternum between the third male legs with a small conic tubercle on each side.

Family CHYTODESMIDAE

Docodesmus cubensis Loomis

Bull. Mus. Comp. Zool., **75**, no. 5, p. 225, 1937.

One female collected between 2000 and 5000 feet elevation, and one male between 5000 feet and the summit of Pico Turquino, June 16 to 21, 1936.

The characters given in the original description are exhibited by these specimens except that the apex of the ventral crest of the third female segment is slightly curved instead of being straight.

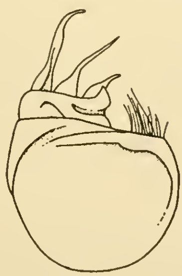

Fig. 25. *Docodesmus cubensis.* Gonopod, outer lateral view.

The male has the anterior legs very close together, the coxae almost touching; neither legs nor narrow sterna have special lobes. The gonopods have the basal joint hemispherical; outer portions consisting of three rather slender, erect arms of which the anterior one is longest and distally curves inward and backward (Fig. 25).

Family STIODESMIDAE

DARLINGTONIELLA new genus

Type. D. provecta new species.

Diagnosis. Associated with *Lophodesmus* and *Cynedesmus* but the pores are advanced in position, being on the margin of the middle lobe of the lateral carina instead of on the posterior lobe, at the corner of the carina, as in those genera and others of the family.

Description. Body small, parallel-sided, a little over four times as long as broad; dorsum moderately arched, with lateral carinae low and projecting far from the sides of the body.

Head completely covered by the first segment; vertex indefinitely sulcate at middle; front with a ridge on either side extending outward from in front of the antenna; clypeus and labrum much narrower than the front; antennae rather large, clavate, the fifth joint surpassing the others in length and thickness; joint 7 almost as long and thick as joint 6.

First segment with disc convex and with two transverse rows of small tubercles; anterior margin nearly smooth, broadly rounded, expanded over the head and divided into ten quadrate areas; posterior margin on each side converging rapidly to the transverse median portion.

Second segment as broad as the ensuing segments, the lateral carinae projecting forward somewhat, the outer margin long, 3-lobed; dorsum and that of succeeding segments with four longitudinal rows of two or three quadrate areas, each containing a small tubercle. Segments 3 and 4 with lateral carinae extending straight out, the outer margin of each short, bilobed. Ensuing segments 3-lobed to segment 16 after which the carinae are somewhat produced backward and have only two lobes on the outer margin. Pores opening outward and slightly upward from a special callus on the outer margin of the middle lobe of the carinae of segments 5, 7, 9, 10, 12, 13, 15 and 16. Last segment small but not hidden from above, with three long, slender, setiferous tubercles on each side of the dorsum; a slightly deflexed quadripapillate process beneath the apical lobe. Anal valves slightly convex, with thickened, raised margins. Preanal scale subtriangular, the apex narrowly truncated.

Legs slightly exceeding the sides of the body, the sterna quite narrow, furrowed in each direction.

Gonopods large and projecting much below the level of the legs, the basal joint hemispherical, the outer joint heavy, terminating in several uncinate lobes.

DARLINGTONIELLA PROVECTA new species

Three males (one the type) and three females from between 2500 and 3500 feet elevation, Buenos Aires, Trinidad Mountains, Santa Clara Province, May 8–14, 1936.

Description. Length 13 mm, width 3 mm; color of dorsum dull jet black in fully colored specimens, in others the lateral carinae are light colored in part, the remainder irregularly overlaid with black; in all the pore calluses are uncolored; vertex of head black, sharply limited at the front, the remainder of the head uncolored; antennae with five basal joints white, the two outer ones dark; legs, sterna, anal valves, preanal scale, and the papillate process of the last segment white.

Head with vertex slightly irregular, an indefinite longitudinal furrow present at the middle; surface uniformly minutely granular; front transversely rugose and finely hispid, each side raised from in front of the antennae outward into a distinct ridge behind which is a depression which may receive the antennae (Fig. 26*a*); clypeus and labrum much narrower than the front and somewhat swollen, shining and nearly glabrous. Antennae finely pubescent, with a few additional long setae near the end of joints 1 to 6, especially the latter; joint 5 considerably longer and wider than any other; joint 6 with a small velutinous pad of hairs near the outer distal limit; joint 7 almost as long as joint 6.

Segments 1 to 6 shown in figure 26*b;* the surface of all segments minutely granular with a few small tubercles in definite arrangement and, except on segment 1, each tubercle in the center of a quadrate area faintly indicated by slightly impressed lines, four longitudinal rows each containing three such areas on each segment but on segments 2 and 3 the anterior tubercle of each row is incorporated in a raised rim completely crossing the front margin of the segment, on ensuing segments these tubercles are farther back and the raised rim is confined to the lateral carinae; near the middle of the base of each carina is an additional tubercle not included in a quadrate area; lateral carinae of segments 2 and 5 to 16 with three outer lobes; segments 3, 4, and 17 to 19 with two outer lobes, the latter segments including segment 20 shown in outline in figure 26*c*. On segments 18 and 19 the two inner rows of tubercles are raised almost into ridges, the last tubercle in each row projecting beyond the posterior margin, especially on segment 19.

First pair of legs considerably smaller than those which follow (Fig. 26*d*) and with the joints more nearly equal in length, the second and sixth joints longest, on the other legs the 6th joint is longest but

the third joint is next in length; sterna quite narrow, the transverse furrow more pronounced than the longitudinal one. Male with third joint of third legs enlarged and with an additional swelling on the

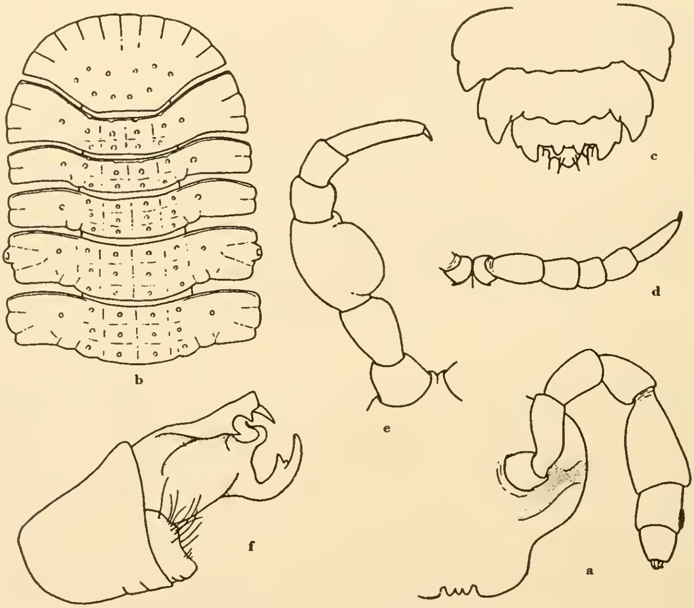

Fig. 26. *Darlingtoniella provecta.* *a*, Partial view of head from in front; *b*, Segments 1 to 6, dorsal view; *c*, Segments 17 to 20 in outline, dorsal view; *d*, First male leg; *e*, Third male leg, same scale as *d; f*, Gonopod.

ventral side as shown in figure 26*e*. Females with the ventral margin of the third segment raised into a short, thin but high lobe behind the second pair of legs.

Gonopods shown in figure 26*f*.

Family COMODESMIDAE Cook

Synonym: *Vanhoeffeniidae* Attems, 1914.

Attems' association of Pocock's *Cylindrodesmus* with related genera in a family group to which he gave the name *Vanhoeffeniidae* overlooked O. F. Cook's[1] inclusion of this genus in the family *Comodes-*

[1] Amer. Nat., p. 415, May, 1896.

midae[1], a valid family name having priority over that proposed by Attems.

Hystrichodesmus new genus

Type. H. cubensis new species.

Diagnosis. This remarkable milliped has a pore formula not duplicated in any other known species of diplopod, the pores occurring on segments 5, 7, 8, 10, 11, 13, 14, 16–19 in the male, plus segment 20 in the female, the total number of segments being 20 and 21 respectively for the sexes. In no other genus of the Merocheta does segment 8 have a pore, except genera with an almost continuous formula such as the unrelated *Strongylodesmus* Sauss. (5, 7–19), and *Homodesmus* Chamb. (5, 7–18). Lack of pores from segments 9, 12, and 15 is unusual but not unknown. The length of the erect dorsal setae, giving the appearance of a caterpillar or tiny elongated porcupine, also probably is not closely approached in known millipeds.

Genera closely related to *Hystrichodesmus* have not been found in the Western Hemisphere, and although superficially resembling the Javanese *Mastodesmus* Carl, which has shorter dorsal setae arranged in much the same manner, and pores opening outward from between papillate tubercles of the carinal margin, the normal pore formula of *Mastodesmus* belies close affinity.

Description. Body small, under 10 mm long and 1.5 mm wide, the males with 20 segments, more slender and flatter than the 21-segmented females.

Head large and thick, the large strongly convex vertex not interrupted at the front; clypeus much narrower than the front and raised above it; antennae moderately short and stout.

First segment narrower than head, semicircular, strongly arched transversely; surface with an anterior and posterior marginal series of very long erect setae rising from definite tubercles, and two intermediate series, surface elsewhere finely granular.

Ensuing segments with prozonite strongly constricted behind at the junction with the metazonite, the latter with an anterior, median, and posterior series of very long setae rising from tubercles as on the first segment, the outer tubercle of each series on the margin of the thick,

[1]Although in the Chordeumoidea the characteristic dorsal setae, fixed in number and position, rarely are of greater length than those of the present genus it is probable that they have originated by different evolutionary processes and should not be confused or compared, as vestiture, with the setae or hairs on the dorsum of other millipeds.

moderately projecting carinae, the three tubercles occupying almost the entire margin. Carinae projecting from opposite or below the middle of the body; pores small, opening outward and slightly downward from the margin between the second and third tubercle of segments 5, 7, 8, 10, 11, 13, 14, 16, 17, 18, 19 in the male, plus 20 in the female.

Last segment slightly exceeding the anal valves, the apex a little deflexed and with the usual four papillae. Anal valves inflated, without specially elevated margins. Preanal scale broadly truncated at apex.

Legs with the outer joint long and slender, extending beyond the sides of the body; sterna elevated in the male but not in the female. Second legs of male each with a long seminal process at the inner corner, the other legs in front of the gonopods without special modifications.

Gonopods with basal joint small; the proximal portion of the outer joint rather slender, the distal portion heavy, with a strong arm extending mesially.

Hystrichodesmus cubensis new species

Three males, one the type, and one female collected between the 5000 feet level and the summit of Pico Turquino, Oriente Province, June 16–21, 1936.

Males flatter and slightly more slender than the female, measuring 8 mm in length and 1.3 mm in width, the female a little wider. Male with 20 segments, female with 21. Color dark reddish brown in alcohol.

Head as shown in figure 27*a*, with a large evenly convex vertex faintly sulcate at middle, posterior half minutely granular, anterior half sparcely hispid, remainder of head more densely hispid; clypeus much narrower than the frontal region, the surface swollen and raised above it; antennae widely separated, short and moderately clavate, joint 6 longest and broadest, the last joint half as long.

First segment narrower than the head, semi-circular, strongly arched, with the lateral corners low, rounded, and partly hidden by the forward production of the carinae of segment 2; surface above the corner swollen or shoulder-like; segment crossed transversely by four series of very long, erect setae borne on small tubercles, an anterior marginal row with 12 to 14 setae, second row with 8 setae, third row

with 4 setae, and the fourth row of 10 to 12 setae on the posterior margin; surface finely granular between the setiferous tubercles.

Second segment with lateral carinae produced forward, partly hiding the lateral corners of the first segment; ensuing segments with

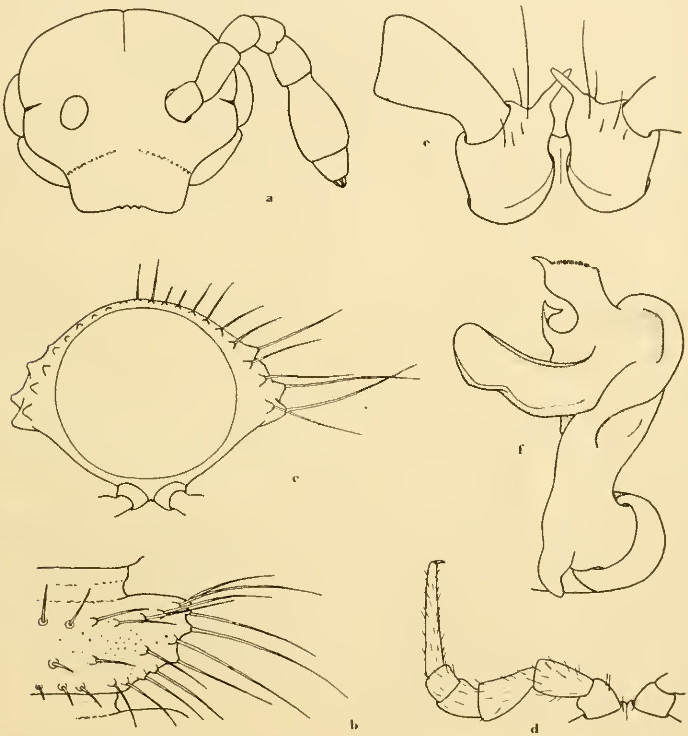

Fig. 27. *Hystrichodesmus cubensis.* *a*, Head, anterior view; *b*, Half of segment 12 of male, dorsal view; *c*, Segment 12 of female, posterior view; *d*, Leg and sternum from middle of body; *e*, Basal joints of second legs of male, anterior view; *f*, Gonopod.

carinae projecting laterad, the metazonites widest along the anterior margin, the outer margins converging caudad.

Body segments, beginning with the second, have the prozonite convex in front and evenly reticulated, but with a broad, deep constriction behind containing much smaller reticulations. Metazonite abruptly

raised from the prozonite and strongly convex, crossed by three transverse rows of setiferous tubercles, 14 to 16 in the first row, 12 in the second, and 16 to 20 in the last row; the setae of the first two rows longest but in all three rows the outer setae are longer and surmount larger tubercles than the inner ones, the longest setae equal half the width of the body, figure 27*b*, surface between the tubercles finely granular and minutely reticulated. Dorsum strongly arched in both sexes but more so in the female, the lateral carinae at the middle of the side in the male but below it in the female, figure 27*c;* carinae thick and not greatly projecting, the outer margin occupied by the large setiferous tubercles at the end of the dorsal series; carinae of the antepenultimate segment well developed, those of the penultimate reduced to a low, inconspicuous ridge; pores small, opening from the outer margin of the carinae directly between the second and third tubercles which are more widely separated than on the non-poriferous segments. Ventral surface of segments without a pleural ridge just above the legs.

Last segment conic, exceeding the anal valves, the quadripapillate apex slightly deflexed; surface with an anterior row of 12 long setae, a middle row of 10, and two setae behind, with an additional one on each side of the apex. Anal valves without raised margins, each valve with a broad, indefinite depression paralleling the opening about half way between it and the outer margin. Preanal scale a truncated triangle in shape with a seta at each posterior angle.

Sterna narrow, scarcely separating the legs; somewhat elevated in the male but less so in the female, the anterior and posterior sternum of each segment sharply separated. Legs, as shown in figure 27*d*, with last joint slender, as long as the three preceding joints together, wholly extending beyond the side of the body. Second male legs with long seminal processes, figure 27*e*. Other male legs unmodified.

Gonopods as shown in figure 27*f*.